

CIO

THE JOURNAL FOR INFORMATION EXECUTIVES

DECEMBER 15, 1995

JANUARY 1, 1996

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SPECIAL ISSUE
WHAT WILL
THE FUTURE
HOLD
I.T. IN THE NEXT MILLENNIUM

Privacy

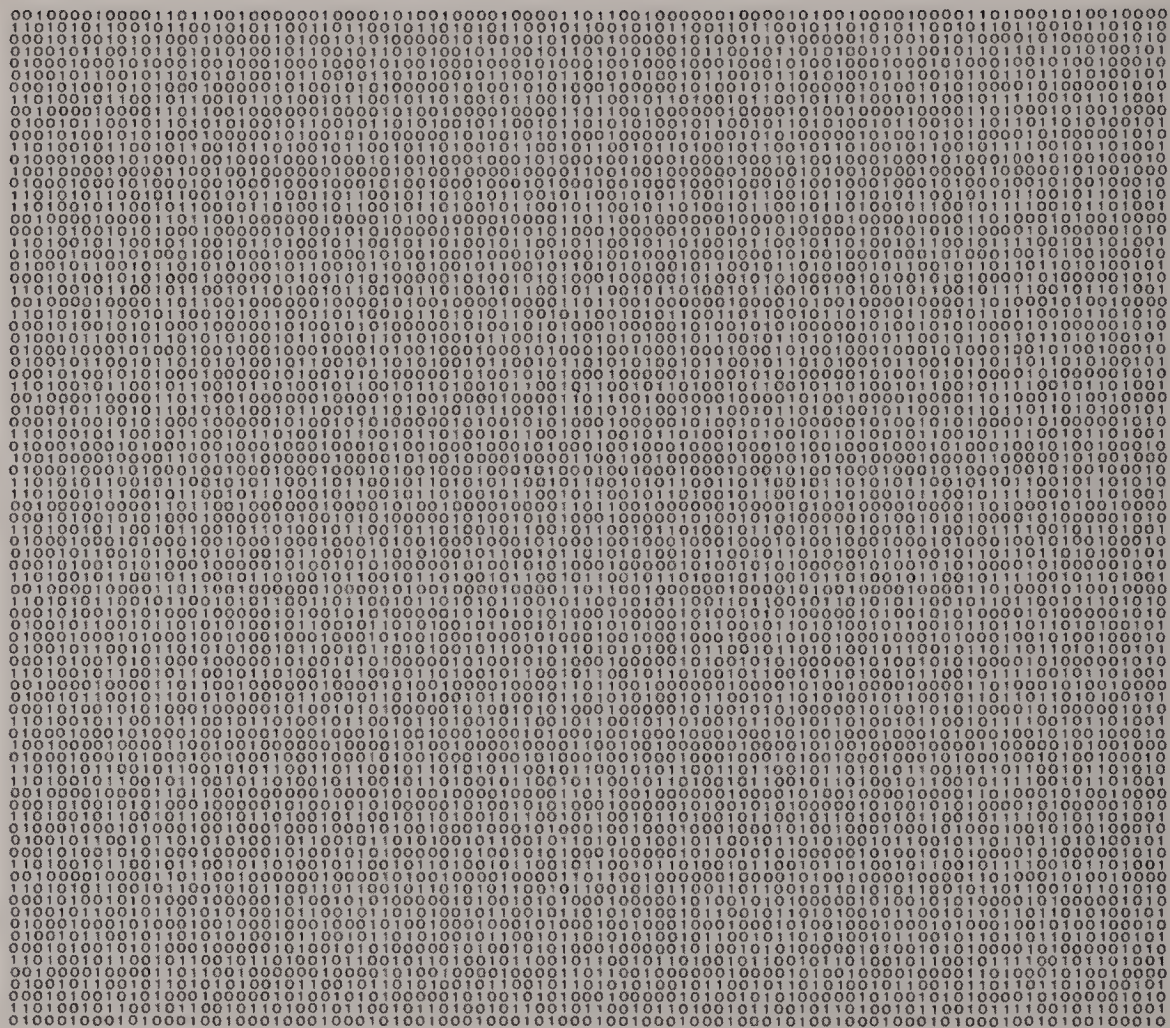
is a business issue

to scale up our collaborative efforts
is going to be very important

not just cogs in a process.

People are

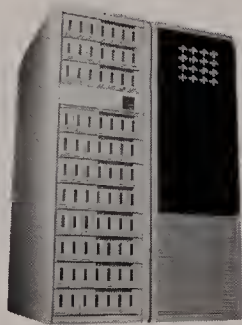
Your customer data has never really given you a clear picture of your customer.



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Decision support is one promise of information technology that has never been fully realized. Its aim is to help you uncover trends hidden in your databases, so you can manage information to satisfy customers and compete more vigorously.

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and offers unsurpassed
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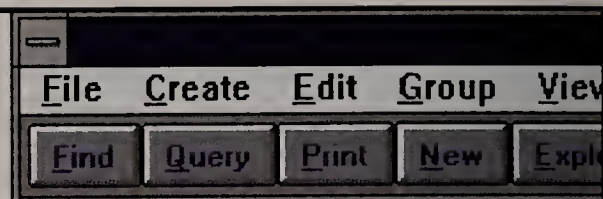
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complete solution, Unisys is deploying a
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support consulting and implementation.

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Customer Order Status

Form Row Field Help

41

Cust No: 1536 State: CA

Name: PB Publishing, Inc. Zip: 94700

Street: 72 Hopkins Court Contact: Evan Michels

City: Berkeley

Escalation Status: None Low High

Open Row Open List

Order No	Order Date	Order Status	Opts Lock
125	12-dec-1994	Closed	12
145	01-Jan-1994	Pending	3
246	18-Jan-1994	Pending	1
298	27-Feb-1994	Pending	23

Frame Editor: OrderStatus

File Create Edit Group View Arrange Appearance Bias Frame Help

100

Cust No: State:

Name: Zip:

Street: Contact:

City:

Escalation Status: None Low High

Open Row Open List

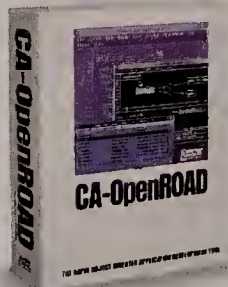
Order No	Order Date	Order Status	Opts Lock
0		Pending	5
0		Pending	5
0		Pending	5
0		Pending	5

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CIO

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Burning questions **36**
Cover photo by Logan Seale

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In this special year-end issue, we explore IT and business trends in the next millennium.

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The Yellow Brick Road

We may not know what lies at the end of this path we're on, but one thing's for sure—this definitely isn't Kansas anymore.

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The Adventures of Orrin Fancher, New Age CIO

Meet fictitious future CIO Orrin Fancher. He comes from the year 2005, a time when simulations are better than the real thing; when employers configure the workforce daily; and when Rangoon, Rotterdam and Rochester can whisper sweet workgroup nothings in your ear at any hour of the day or night.

By Lew McCreary

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Going the Distance

Technology pioneers experiment with faster, cheaper ways to deliver data, text, graphics, sound and video. Some innovations will change the ways we live; others will go the way of the 8-track tape deck. But all will serve as milestones on the road to the 21st century.

By Anne Stuart



The not-so-far-fetched future
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MORE >>>

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Traditional strategic planning is fine for a stable, predictable world. So what do we do now? *By Susan Grandpierre*

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STATE OF THE ART: NEW YEAR'S EVIL

With a virtual time bomb ticking away in mainframes everywhere, many CIOs have some serious issues to deal with before they can party like it's 1999. *By John Edwards*



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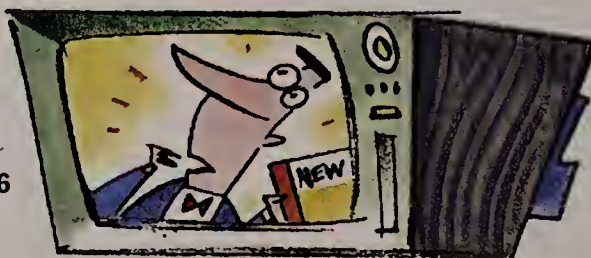
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CIO LIGHT: FUTURE SHTICK

Why settle for the limited knowledge afforded by short-term business forecasts when you can find out with absolute certainty what your customers and competitors will be doing in the year 3000 and beyond? *By Ezra Poundcake*

On a clear day, he
can see forever
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You go swimming only minutes after eating.

You walk under ladders.

You use a butter knife to remove toast from the toaster.

Then you go and test your client/server design at an IBM Open Systems Center.

So much for your daredevil image.



**Can your
computer
company
do this?**

Even those who live on the edge know they shouldn't take chances when designing a client/server system for their business. With so much to be gained, everything has to go just right.

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It's hard to believe that only 15 years ago we worked without the benefit of a lot of the technology we now take for granted. We processed information without personal computers. We shared it without local or wide area networks, fax machines or the Internet. We communicated without cellular phones, pagers or e-mail. We've come a long way.

Where are we going? What do the next 15 years hold? How will our professional lives change? And how will technology shape that future? This special issue looks ahead at information technology in the year 2000 and beyond. It's an exciting picture.

The next millennium will be what Gordon Bell, the man responsible for the VAX minicomputer, calls a world of "everything-to-everything connectivity." Global connectivity will be enabled by universal, high-speed networks and computer platforms that are scalable in time, space and size. (Please see "Communications: Anywhere, Anytime, Any Medium, Any Day Now," Page 72.)

Telecomputing, the term used to describe the convergence of computer, telephone and video technology that is now underway, may ultimately be regarded as one of a handful of crowning technological achievements, some futurists believe. As Senior Editor Anne Stuart reports in "Going the Distance" (beginning on Page 62), eliminating the barriers of time and distance has already revolutionized such fields as medicine, banking and education.

If you prefer a future that is virtual instead of real, join Consulting Editor Lew McCreary as he fast forwards to the year 2005 and spends a day with a fictitious CIO of the future named Orrin Fancher. (See "The Adventures of Orrin Fancher, New Age CIO," Page 54.) Fasten your seat belt.

The millennium does have a glitch or two. Contributing Writer John Edwards warns of the year 2000 problem—that moment at the stroke of midnight on Dec. 31, 1999, when date fields in computers everywhere change to "00." But those computers will read "00" and think of the year 1900, not 2000. Fixing the faulty date logic will cost an average midsize company \$3.6 million to \$4.8 million, Edwards reports (see "New Year's Evil," Page 82). Better hurry if you intend to amortize those conversion costs over the next two or three years.

Technology can change everything. But as Paul Saffo, research fellow at the Institute of the Future, reminds us: "Change is enabled by technology, but technology is not a driving force. We could elect to not change anything at all if we wanted to." The choice is ours.

Best wishes for a happy holiday season and a prosperous New Year from all of us at *CIO*.

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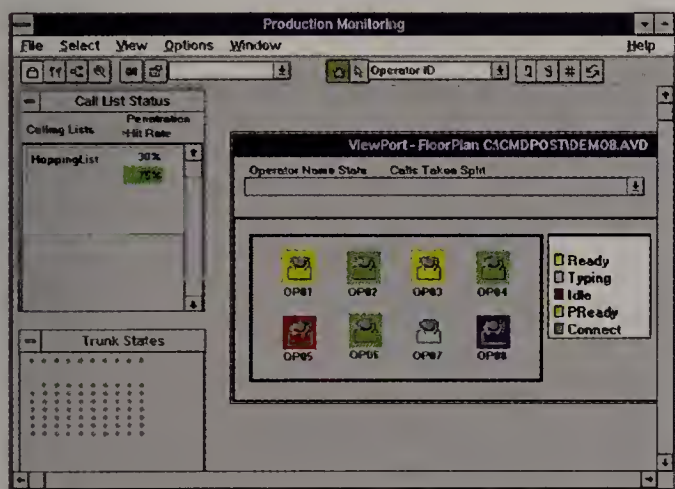
*David Eyestone, Vice President,
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This entire issue is dedicated to the future—except this letter. I would like to devote this space to discussion of the recent past. This past year to be more exact.

International Data Group (IDG), our parent company, just honored CIO Communications as Entrepreneur of the Year. The success of both *WebMaster* magazine, a supplement to *CIO*, and CIO Online (<http://www.cio.com>) clinched it for us. But better than getting kudos from IDG, the staff at *CIO* relishes the words of praise from our readers. The response to *WebMaster* and CIO Online has been overwhelming. At recent trade shows, copies of *WebMaster* flew

out of our booth at a rate we've never witnessed before.

It was exactly one year ago when Lew McCreary, editor and publisher of *WebMaster*, came to me with his vision. In just six months, the staff at *CIO* rose to the challenge of producing a brand-new supplement, promoting it and building its circulation. The final product in June 1995 was so well-received that the post office could not keep up with circulation requests.

And as this year comes to a close, we are proud to announce a new venture: The WebMaster Perspectives Conference. *WebMaster* magazine is coming to life. The conference will take place Aug. 11-14, 1996, at the Westin St. Francis Hotel in San Francisco. Don Tapscott, chairman of the Alliance for Converging Technologies, president of New Paradigm Learning Corp. and co-author of the bestselling *Paradigm Shift*, will be the conference moderator. Meet and network with executives facing similar business challenges and opportunities, and learn how to effectively conduct business for profit on the World Wide Web. For more information, please call 800 366-0246.

Lew McCreary

P.S. Be sure to join us March 17-20, 1996, at the CIO Perspectives Conference—The CIO and Cyberspace: The Business/Technology Intersection—in Naples, Fla. We will explore the executive's role in Web and Internet corporate initiatives. For more information, call 800 366-0246.

Coming In CIO

Fuzzy Thinking

Artificial intelligence—things like fuzzy logic, genetic algorithms and neural networks—is being used by more than 70 percent of the Fortune 500, according to the U.S. Commerce Department. What are these technologies? How are they being used in banking, manufacturing, health care, and marketing services today, and what can we expect five years from now? Learn what role the CIO plays in discovering and implementing new applications based on AI.

Buying IT

Four IT executives compare notes about the changing role of the CIO when it comes to technology procurement and the effectiveness of preferred vendor programs. What are the trends and where are they headed?

Methodology Redux

A recent *CIO* column on methodology drew varying levels of agreement, contempt and outrage from a group of consultants. *CIO* will revisit the topic and excerpt their remarks.

Nimble Networks

Brussels-based SWIFT, a global cooperative that transmits interbank financial transactions, must provide high-reliability network services to low-tolerance customers and owners in 130 countries. The biggest challenge is to improve service and push the technology envelope without overwhelming the conservative owners, who, by the way, expect a nice rebate at the end of each year.

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A SPACE ODYSSEY

Ah, the wonders of telecommuting! Today's employees actually have a choice: They can slave away in sick, windowless buildings, breathing stale air and trying to ignore the cackling in the next cubicle, or they can labor at home in windowless basements, trying to ignore crying babies and dreaming of the good old days back at the office.

But perhaps the future holds a third, better option, says Volker Hartkopf, professor of architecture at Pittsburgh's Carnegie Mellon University and director of its Center for Building Perfor-

mance and Diagnostics (CBPD). Happily, Hartkopf foresees a future of friendly, comfortable, intelligent workspaces. And rather than just forecasting the future, he is attempting to build it right on top of the university's Margaret Morrison Carnegie Hall.

This 7,000-square-foot rooftop addition, dubbed the "intelligent workplace," will be a research, teaching and demonstration facility to study how different building components, systems and assemblies affect building and employee performance. The facility's guinea pigs—CBPD faculty, graduate students and staff—are scheduled to move in by early summer. With the help of the Advanced

Building Systems Integration Consortium (which includes major corporations in



"I'll be a nuclear physicist in 2010. My lab will have a three-dimensional radiation detector with a screen."

—ALEX F., AGE 9

DID I SAY THAT?

"Computers in the future may weigh no more than 1.5 tons."

—Popular Mechanics, forecasting the relentless march of science, 1949

"But what...is it good for?"

—attributed to an engineer at the advanced computing systems division of IBM, commenting on the microchip in 1968

The Hewlett-Packard OmniGo 100 weighs 11.6 ounces. It has a 16-bit 80186-based CPU, 3MB of ROM and 1MB of RAM, and it sells for about \$350.

—Hewlett-Packard Co., 1995



the building industry, the Environmental Protection Agency and the U.S. Department of Energy), they will test innovations in temperature and enclosure systems as well as new products that improve interior air, visual, acoustic and spatial quality.

"Corporations spend about \$7,000 to \$8,000 per employee to outfit them with computers, phones and other equipment, but executives regularly overlook the losses from poorly designed, unproductive physical workspaces," says Hartkopf. "Studies show those productivity losses can be as high as \$8,000 per employee."

So try this alternative vision on for size: When employees come to the office and sit at their mobile workstations, they can plug into a "cave" for private concentration or into a "commons" for group tasks. They begin work after customizing air temperature, task lighting, radiant heat and white-noise levels through program controls at their desktops. Occasionally an employee looks up from his endeavors, gazing past

the multilayered shading and light-redirection devices with high-visibility glass, to look at the world outside.

—E.B. Baatz

Top 10 Technologies

of the next 10 years, ranked by importance

- 1 Genetic mapping**
- 2 Super materials**
- 3 High-density energy sources**
- 4 Digital high-definition television (HDTV)**
- 5 Miniaturization**
- 6 Smart manufacturing**
- 7 Anti-aging products and services**
- 8 Targeted drug-delivery systems and medical sensors**
- 9 Hybrid-fuel vehicles**
- 10 "Edutainment"**

SOURCE: BATTELLE, COLUMBUS, OHIO, 1995

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MR. BLANDINGS DOWNLOADS HIS DREAM HOUSE

Envisioning what a new house will *really* look like from old-fashioned blueprints or even CAD drawings can be tough. But

experts predict that within 10 years, architects will design homes with photo-realistic 3-D graphics, giving prospective home buyers a much more accurate picture. Architects will download virtual windows from a window company's Web site, doors from a door company's site and plumbing fixtures from a fixture company's site; by attaching these files to the design plans, they can show the customer what the finished product will look like. Using a virtual reality system, the customer will be



provides the means to transfer 3-D graphics over the Web, allowing users in multiple platforms to share 3-D files. As more users acquire more processing power and bandwidth, the technology is bound to take off,

Larson-Mogal says.

able to stroll through the unbuilt abode to get a feel for its proportions or figure out where to stick the trash compactor.

The 3-D graphics software now used in video games and CAD engineering will work its way into commercial areas over the next decade, says Joshua Larson-Mogal, enabling technologies manager for the Advanced Systems Division of Silicon Graphics Inc. in Mountain View, Calif. Because of processing demands, 3-D graphics have so far been restricted to workstations and higher-end machines. But with the recent introduction of more powerful microprocessors, "the PC world is undergoing a revolution in 3-D graphics," says Larson-Mogal. The Virtual Reality Modeling Language (VRML) standard already

Advances in 3-D will also make movie and television production cheaper. Today, when a weather forecaster points out an advancing cold front on the map, he or she is actually pointing to a blank blue screen; the digital weather map is added to the scene electronically as it is broadcast. Within a decade, that technology will enable cameras to shoot from multiple angles with appropriate light and shadow effects, allowing one studio to function as the set for several shows. Likewise, movie makers will have the option of shooting in myriad exotic locales from a single studio. Perhaps with this technology, Kevin Costner's *Waterworld II* won't be the boondoggle the original turned out to be.

—Peter Fabris

SNACKS OF TOMORROW

We can spend much of our lives—and a lot of money—trying to figure out what it is we really need. Companies are as interested in our needs as we are, but until recently their luck hasn't been much better. Some companies are beginning to gain an edge, however, with powerful database analysis tools.



"We can now identify a particular collection of needs that is not being met two years ahead of time," claims Bob Posten, managing partner of The Landis Group. The West Palm Beach, Fla., company offers market analysis

powered by Matrix, a software package that sifts through customers' yearnings.

"We're seeing a shift in market research from gathering data to guidance," says Posten. "We've had the data for years, but only recently have we had the tools to make it come alive and tell us what to do." Matrix puts hundreds of customer variables into a window that looks like an air traffic controller's screen and lets users manipulate and analyze the data to come up with the next great trend in, say, snack foods. The future here, according to Posten, portends a blending of health and taste that will lead to what he calls "nutraceuticals," good tasting foods that provide health and medical benefits. Who knew? ■

SO I WAS WRONG. SUE ME.

"I think there is a world market for maybe five computers."

—attributed to Thomas Watson, chairman of IBM, 1943

"There is no reason anyone would want a computer in their home."

—attributed to Ken Olsen, president, chairman and founder of Digital Equipment Corp., 1977

Personal computers will outsell television sets in the United States for the first time ever in 1995, generating \$10.3 billion in revenues to the \$8.9 billion made in TV sales.

—Electronic Industries Association, Arlington, Va., 1995



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THE CIO AND CYBERSPACE:

THE BUSINESS/TECHNOLOGY INTERSECTION

MARCH 17-20, 1996 ■ RITZ-CARLTON ■ NAPLES, FLORIDA



Jim Wetherbe, PhD
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Alan Kay, PhD
Keynote Speaker



Tom Davenport, PhD



Michael Eaton

The CIO and Cyberspace: The Business/Technology Intersection

MARCH 17-20, 1996 ■ THE RITZ-CARLTON ■ NAPLES, FLORIDA

Within the next five years, over 50 million people will be accessible through the Internet. An enterprise wide strategy must be implemented to ensure a business value return from this new distribution and marketing channel.

However, even before educational, technical and legal issues can be addressed, corporate culture will need to be restructured. The traditional corporate hierarchy will have to evolve into a more flexible organization, emphasizing teamwork, collaboration and distributed decision making, and combining the immediate communication needs of a business with its long-term strategic goals for network participation.

CIOs, whether or not they currently play a role in their organization's efforts to do business on the Internet, had better be prepared to get involved or get washed away by the wave.

CIOs who educate themselves and learn how to work with the Internet community will grow into productive, valued members of cyberspace, become internal Internet champions and assume a corporate leadership role in this boundless zone.

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Dr. Jim Wetherbe, Director, MIS Research Center, University of Minnesota, and Federal Express Professor of Excellence and Director, Center for Cycle Time Research, University of Memphis, will again moderate the *Perspectives* program and set the stage for our discussions.

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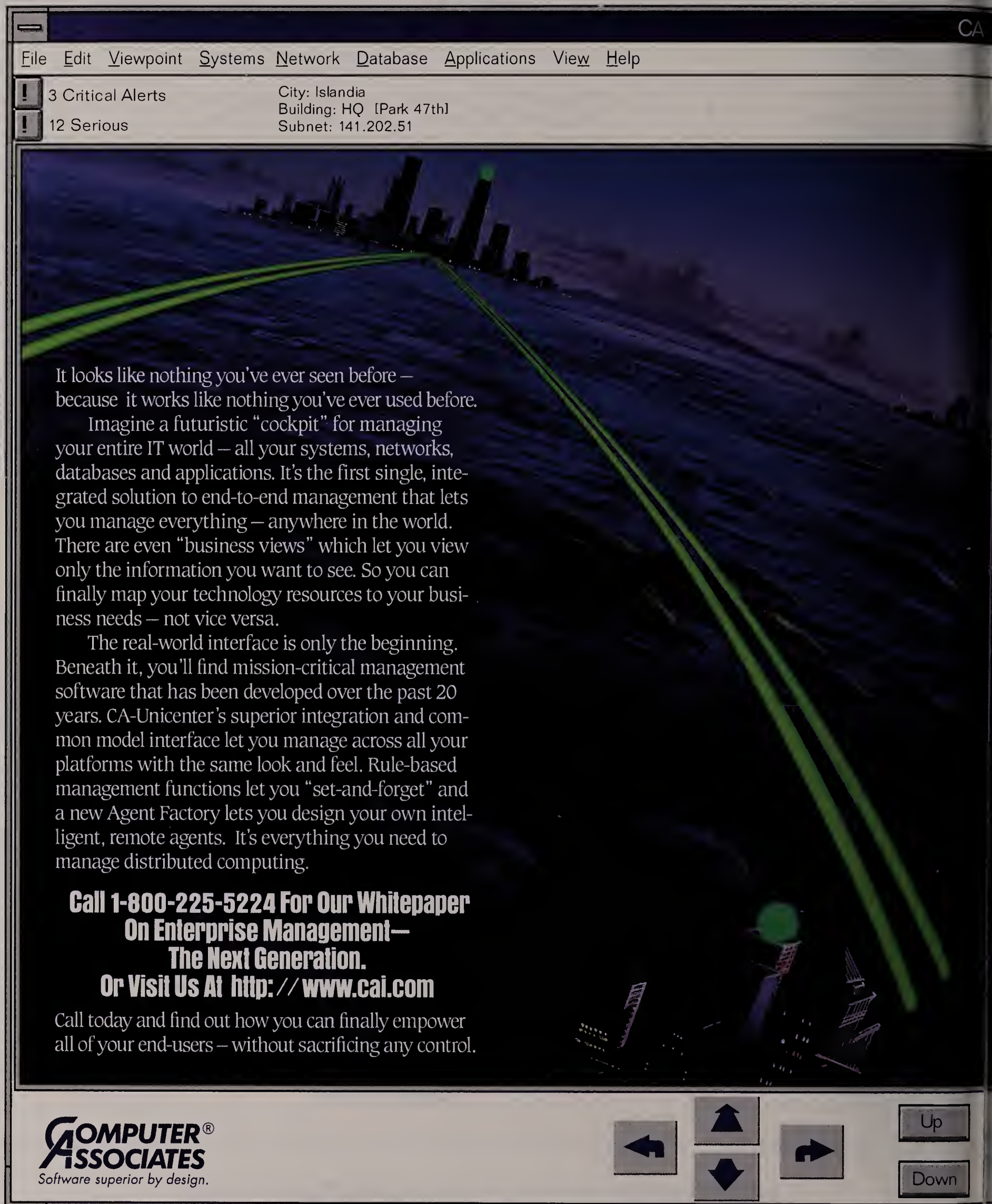
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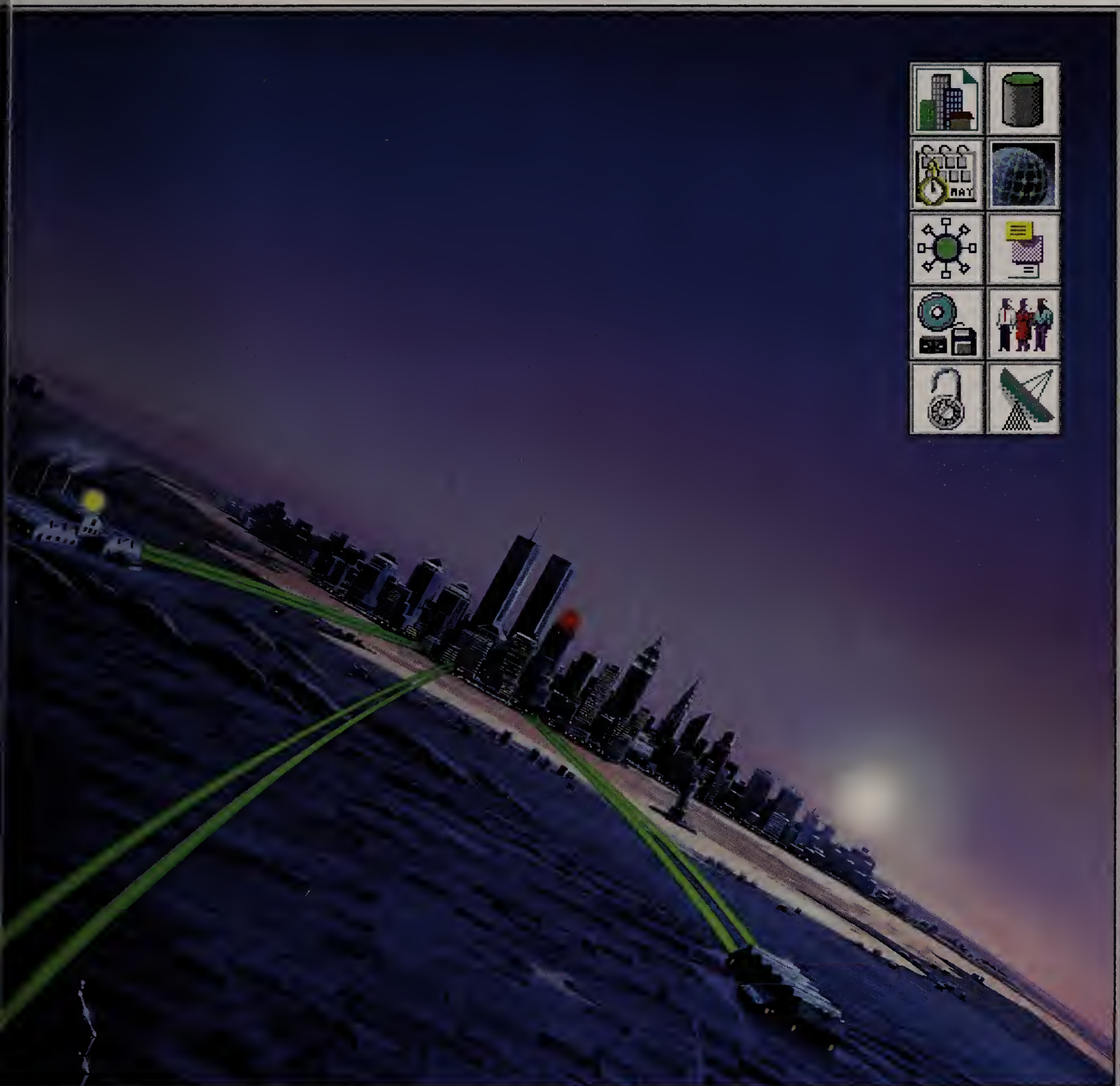
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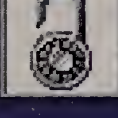
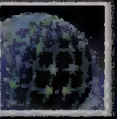
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TRENDLINES

SMART BUILDINGS

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Lower Manhattan's financial district may soon become a mecca for high-tech as well as high finance if real estate developer Rudin Management Co. Inc. has its way. New York-based Rudin has nearly completed a \$15 million project to convert an outdated building into a state-of-the-art center for emerging new-media companies.

Located at 55 Broad St., the New York Information Technology Center (NYITC)



offers the latest and greatest in communications technology.

With a mission of becoming the nerve center of New York's IT industry, the 31-story NYITC is outfitted with fiber-optic and high-speed copper wire as well as ISDN and T-1 and fractional T-1 lines to enable Internet, LAN and WAN connectivity; voice, video and data transmission; and satellite accessibility.

Rudin is looking to attract up-and-coming high-tech companies, including multimedia software developers, hardware manufacturers and Internet service providers, that typically require such services. One of the first to sign a lease was N2K Inc., a Brooklyn software developer that manufactures Jazz Central Station, an interactive, CD-ROM-based jazz catalog.

Although most young companies wouldn't think of opening up shop in pricey Manhattan, they may want to reconsider. Rudin can afford to rent space in the NYITC at about \$15 per square foot—\$5 to \$10 less than the going downtown rate—thanks to property tax breaks afforded by the Lower Manhattan development project. After New York lost

nearly 100,000 jobs to layoffs and relocations, the city launched a revitalization plan for the financial district that includes tax abatements and reduced electricity costs for businesses locating in the area.

The NYITC is the first step in the developer's plan to create a new 24-hour community. Where vital new businesses go, retailers, restaurateurs—and, of course, revenues—will follow, Rudin believes.

The company is touting its endeavor as a prototype for buildings of the future and hoping that it will catch on in residential buildings. For more information, visit <http://www.55broadst.com>.

—Cheryl Davis

LINKS TO THE FUTURE

For a glimpse at tomorrow's technology, visit **The Argonne Computing and Communications Infrastructure Futures Laboratory** at http://www.mcs.anl.gov/FUTURES_LAB/index.html. This cutting-edge lab researches and prototypes next-generation computing and communications systems. The site includes online descriptions of current projects—including the Voyager project, billed as the technology that will “ultimately replace the types of servers that we currently use for supporting collaborative environments” and “provide an extensible environment for making audio, video and other stream-oriented recordings available to others on the network.”

“History repeats itself” may well be the motto at Project Nostradamus, where a social science research team studies past and present patterns in mass psychology to predict the future. **Nostradamus 2000** (<http://www.nostradamus.com>), the group's online subscription service, offers predictions, general forecasts and analyses of political, social, financial and economic issues. The service promises to alert readers to potential financial expansions or collapses as well as domestic and world developments and social trends. Subscriptions start at \$35.

Want to learn more about scenario planning? Then check out the **Global Business Network** at <http://www.gbn.org/>. GBN is a leading think-tank for scenario planning, and its Web site is chock full of futuristic goodies, including advance proofs of business and economic books, chronicles of China in reform and Mexico in flux, and GBN's own scenarios for the possible futures of multimedia.

At **The Santa Fe Institute** (<http://www.santafe.edu/>), researchers and educators explore a broad array of topics including artificial life, the immune system, genetics, and nonlinear modeling and forecasting. The institute's Web site features a rich publications page with links to online scientific journals, including MIT Press's *Artificial Life Online*.



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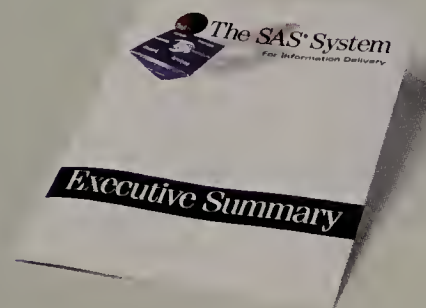


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TRENDLINES

RESOURCES

FORWARD THINKERS

Ever wonder what economic globalization means for the future? In *When Corporations Rule the World*, David C. Korten argues authoritatively that the convergence of ideological, political and technological forces is leading to a crisis in capitalism and offers a devastating critique of the tyranny of the global economy. Some critics have dubbed this the most important business book of the '90s. (Berrett-Koehler, 1995, \$29.95.)

Harmony: Business, Technology & Life After Paperwork, by Nobel Prize winner and Bell Labs researcher Arno Penzias, is a great volume to pass on to your CEO. It outlines big-picture predictions for the next phase of technology brought on by increased user access to information. Penzias chronicles the shift in emphasis from quantity to quality of production and predicts the arrival of a kind of digital harmonic convergence, in which technologies merge and become streamlined. Though the book doesn't provide a blueprint for business, it does herald the sea changes that will drive strategy for CIOs in the future. (HarperCollins, 1995, \$23.)

In *The Digital Economy: Promise and Peril in the Age of Networked Intelligence*, Don Tapscott, chairman of the Alliance for Converging Technologies, identifies 10 important technology shifts

and assesses the implications for business and the emerging digital economy. (McGraw-Hill, 1995, \$24.95.)

The Road to 2015: Profiles of the Future, by John L. Petersen, examines the forces driving change and how they might interact to shape the future. The author delves into trends in science, technology, the environment, politics, the economy, health

and preceded access to information, products and services as well as customized education and entertainment. He predicts that paper currency will give way to "unforgettable digital money" and defines the information highway as not a road but "a marketplace where all manner of human activity takes place,

times a year by The World Future Society of Bethesda, Md., calls itself a journal of forecasts, trends and ideas about the future. A recent issue included articles by Newt Gingrich and Václav Havel as well as Nathan Rosenberg's explanation of why technology forecasts often fail. (\$42 for a 1-year subscription; 301 656-8274.)

Fuzzy Thinking: The New Science of Fuzzy Logic, by Bart Kosko, describes a new

way of seeing the world in shades of gray. For the Western mind, raised on Aristotelian logic, the road to understanding this so-called "cocaine of the scientific world" will be bumpy. But the Japanese already are designing fuzzy logic washing machines. Smart cars. Smart roads. Smart personality profile chips for answering machines. Smart prostheses. *Fuzzy Thinking* is a lively and

provocative guide to the fuzzy future. (Hyperion, 1993, \$12.95.)

Intelligence: The Future of Computing covers neural networks, genetic algorithms and other biologically inspired and mathematically based computational paradigms as well as the Internet and molecular computing. This monthly newsletter features stories on technical trends, new research and innovative products. (\$395 per year in the United States, \$450 elsewhere; 212 222-1123 or ier@aol.com.)



care, space, transportation and more. (Waite Group Press, 1994, \$18.95.)

Fast Company, Mortimer Zuckerman's new bimonthly magazine, calls itself the "handbook of the business revolution" and promises to chronicle the technology- and innovation-driven transformation of the economy. (\$29.95 for a 2-year subscription; 800 688-1545 or loop@fastcompany.com.)

In *The Road Ahead*, Bill Gates lays forth his vision of a globally networked future, in which people will have un-

precedented access to information, products and services as well as customized education and entertainment. He predicts that paper currency will give way to "unforgettable digital money" and defines the information highway as not a road but "a marketplace where all manner of human activity takes place,

from billion-dollar deals to flirtations." (Viking Penguin, 1995, \$29.95; includes a full-text CD-ROM with video clips of Gates' speeches and a tour of his house.)

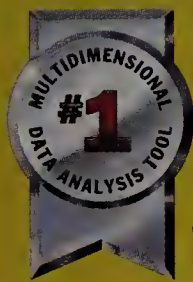
Release 1.0, a monthly newsletter by Esther Dyson, keeps IT professionals abreast of the latest software and communications technologies. Dyson provides a clear perspective on new technology trends that is both insightful and practical. (\$595 for a 1-year subscription in North America, \$650 elsewhere; 212 924-8800.)



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Into the Futures

Traditional strategic planning is fine for a stable, predictable world. So what do we do now?

BY SUSAN GRANDPIERRE

Although everybody pays lip service to the idea that it is best to include the CIO in strategic planning, that rarely seems to happen. There seems to be an unspoken belief among business managers that things simply move too fast to get the information systems function involved up-front. Top management itself barely has the time to think strategically.

The result is that the IS group is often ill-prepared to support new business directions with appropriate systems. What is needed is a methodology to get the business strategy and IS planning processes together in order to effectively position the company ahead of industry/market changes. How can this be accomplished? More and more top companies are turning to scenario-based strategic planning to understand where their industries need to go and what they can do to prepare for the future.

An Uncertain World

Most strategic planning involves a forecast of the future arrived at

through trend analysis based on what has happened in the past. Usually, this future winds up looking suspiciously like the past, only rosier! Once the most likely future has been forecast, plans are crafted to position the company for that future. But what happens if they're wrong? What if the assumptions about the future prove to be unfounded? Put another way, what if the Soviet Union suddenly collapses? What if there's peace in the Middle East? What if the bond market implodes? What if oil prices skyrocket?

Forecasting can be a powerful tool for peeking into the future, but it fails to take one thing into account: uncertainty. Scenario planning, on the other hand, is the only proven technique that focuses systematically on uncertainty rather than ignoring it or wishing it away.

Drivers and Dimensions

Because the corporation is not a closed system, scenario planning begins with the outside world, with the variables that drive the business but are outside the firm's control. These variables are determined through interviews with senior managers and external experts (scientists, U.S. and foreign government officials, etc.) and through extensive independent research. Any and all significant factors having an impact on a business are examined. These include macro-drivers like economic health, regulatory changes and technology, as well as industry characteristics such as industry structure, value chain evolution, competition, new entrants, consolidation and new markets. For example, a scenario project for the U.S. Air Force was heavy on factors that influence global political stability, while a scenario for a fast-food chain included the eating, drinking and entertainment habits of the American family. In a typical scenario project, there will be





They say, "We want client/server."



You say, "What about the time and cost?"



They say, "We need client/server."



You say, "What about systems management?"



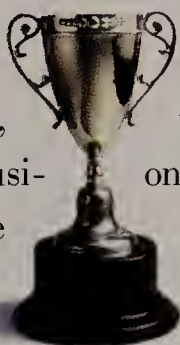
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50 to 100 significant drivers.

Once these external business drivers are identified, they are organized around a few major themes or dimensions, which are driven to their ultimate extremes to define starkly different conditions. If, for example, China might play a significant role in a company's future, we might envision a united, democratic, economically powerful China; a backward, third-world China; a balkanized China at war with itself; an aggressive, highly militarized China preying on its neighbors, etc.

Scenarios

The work of scenario writing consists of assembling these dimensions into detailed portraits of future business worlds tailored to the client company. These worlds are created with multidisciplinary teams of experts—economists, political scientists, engineers, sociologists and whatever additional specialists the situation demands.

Typically, four or five possible worlds must be developed in order to represent a full range of opportunities and threats. They should embrace the greatest number of drivers and dimensions and the greatest possible divergence from one another. Most planning horizons look 10 years into the future, although longer time frames may be necessary. This is the case with pharmaceutical companies, for example, which must take into account an eight- to 10-year FDA approval process for new drugs.

Each scenario world includes a plausible "future history," detailing how that world evolved (or devolved) from the present. These products of the actual scenario writing are the familiar, often science fiction-like accounts of future utopian and dystopian worlds. They are by no means the final product in the planning process.

Adopt-a-World

The next step is to conduct workshops in which each of the scenario worlds is "adopted" by a team made up of senior planning personnel and a cross-section of other executives and fast-trackers. These teams "live" in the world to develop the strongest possible strategic positioning for the



"In the year 2010, I'll be working as a genetic technician for the U.S.A.'s Special Forces military division. I'll be creating all sorts of weird mutant soldiers to defend our country."

—BEN S., AGE 13

firm in that world.

Strategic themes are explored in these workshops; particularly, what opportunities are created by changes in policy, technology, consumer taste, income, etc., and by changes up and down the industry value chain. Management teams determine what it will take to support future developments: new products or services, required competencies, strategic alliances. IS team members help management evaluate when technologies will be ready for commercial use to implement particular strategies.

Robust Strategies

The strategies developed for each world are subsequently analyzed for their viability in the worlds for which they were not designed. Strategy elements that work well in multiple worlds become part of a robust or core strategy. These are the initiatives that can be implemented with the confidence that they will succeed across a broad range of possible industry directions.

The teams must also consider the information technology implications for the robust strategy. If information is to be a part of future products, how will the IS organization integrate that into its delivery system? IS should develop plans for user access and the kinds of interfaces, applications and other services that will be necessary. They will have to think about how to manage the knowledge flows that new connections to new mar-

kets and customers will produce. Standards, architectures and protocols must be specified. And the people aspects of IT will have to be addressed as well, including which new skills will be required and whether those competencies should be purchased or outsourced. Last but not least, IS can help develop the business case for the strategies.

Many Benefits

Strategy development is not the only result of the scenario planning process. A common vision and an understanding of what the future might bring also result. By the end of the process, the organization has, in effect, rehearsed for the future. It understands its own strengths and weaknesses. It knows what it has to fix. It knows the competencies it must develop or acquire.

This exercise also encourages teamwork and creative, flexible thinking throughout the organization. It instills a planning mind-set in the participants and, for the younger fast-trackers, provides a kind of training program in which tomorrow's corporate leaders can be developed.

Representatives of the IS organization should occupy an important place on that team, among those future leaders. Their involvement in the planning process will help them understand what the options are and what management is thinking. They will have time to try pilots with new technologies or look for new applications. They will be better equipped to align the IS organization with the new priorities. They can even help business management evaluate new technical alliances as part of the strategy implementation.

Armed with a vision and an implementation plan, management and the IS organization can feel justifiably confident that future surprises will be the ones they have prepared for the competition. **CIO**

Susan Grandpierre is director of corporate strategy at The Futures Group, an international consulting firm in Glastonbury, Conn. She can be reached at sgrandpierre@tfg.com.

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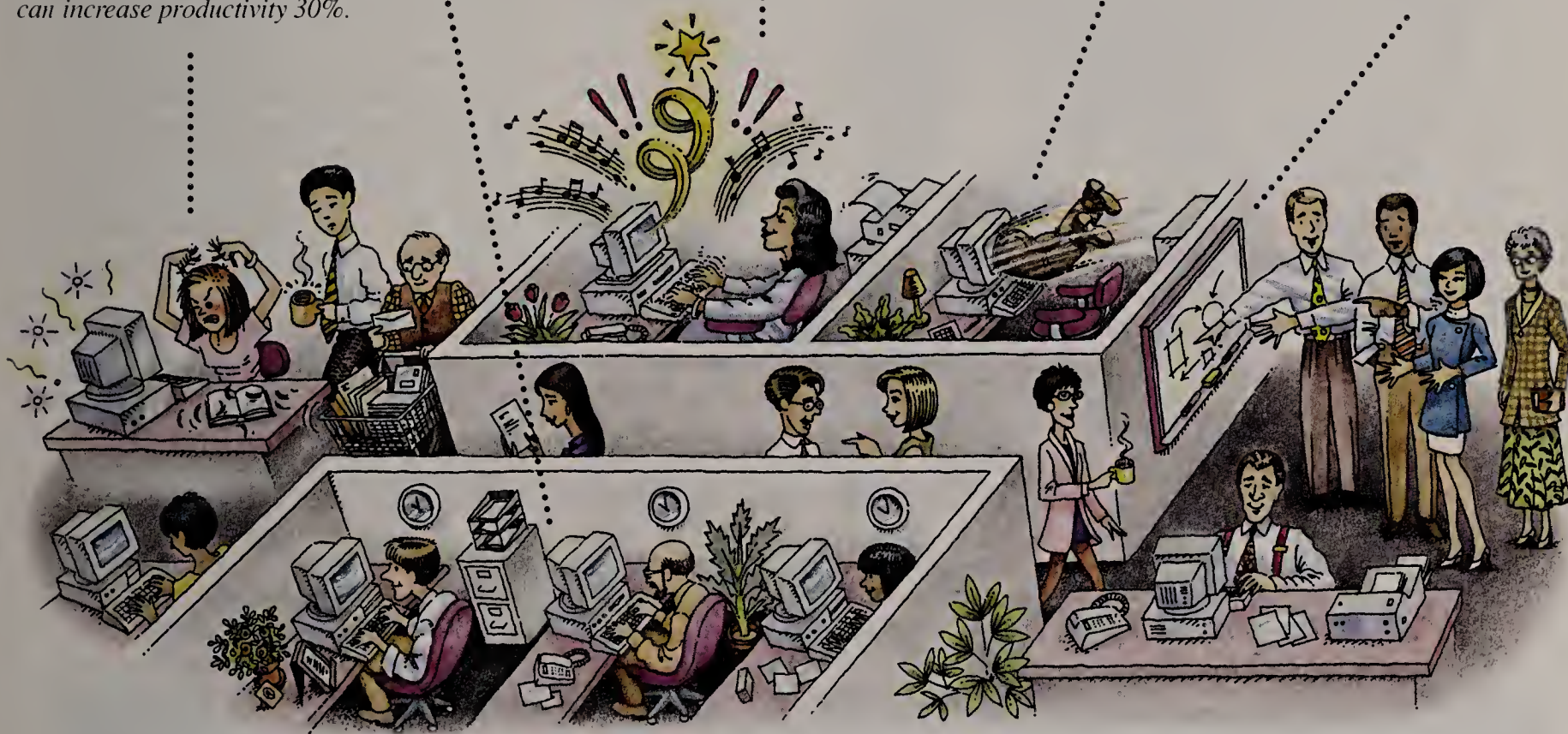
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Think Tank

BY TOM DAVENPORT

The Future of Knowledge Management

WHEN WE THINK of how knowledge will be managed in 10 years, all sorts of futuristic images come to mind. There will be Superfast Ethernet jacks on every knowledge worker's neck allowing knowledge downloads. Our heads will have swelled in "Brainiac" fashion to contain the increased knowledge of the new millennium. Intelligent agents will cruise the InterInterNet, seeking out juicy bits of knowledge wherever they hide. Pocket-sized "knowledge appliances" will pull relevant knowledge from wireless networks and display it on our glasses.

Even if you're a Harry Houdini, however, don't hold your breath until this vision becomes a reality. The most common mistake made by futurists is to overstate technology progress. Technology changes will be incremental, and we've already heard about most of the technologies that will be widespread in 2005.

The two currently leading technologies for knowledge management—Lotus Notes and the World Wide Web—will essentially merge, with database, replication and discus-

sion capabilities combining with hypertext and multimedia features. Hypertext knowledge bases will become capable of generating their own linkages to other documents. Agents will be available, but usage will be restricted by security concerns. The most popular form of agent will perform keyword searches—no big advance over today. Finally, the problems that firms have today with security, 7-by-24 operations and remote access to knowledge databases will largely be resolved by 2005.

Expert systems and neural networks are already being abandoned today, so it takes no Karnac the Magnificent to predict that they won't be a major force in future knowledge management. Good old algorithmic logic programs will be the workhorses of knowledge management, but they will be contained in object-oriented modules for easy maintainability. Individual programs will specialize in specific knowledge functions, e.g., diagnosis, configuration or prediction.

But the most dramatic improvements in knowledge management capability over the next 10 years will be human and managerial. In the next couple of years, knowledge manage-

ment will take off as a management enthusiasm. It will be fueled by some studies or even examples that demonstrate a linkage between knowledge management and economics—reduced costs or increased revenues. Every major consulting firm will (darn near already does) have a knowledge management consulting service. The trickle of titles like Chief Knowledge Officer, Intellectual Capital Asset Manager and VP of Knowledge Transfer will turn into a flood.

What will all these people do to facilitate the management of knowledge? The smart ones will eschew faddism and lay the groundwork for knowledge management. They will address all of the key knowledge management resources—not only technology but also people, content and economics. They will manage all stages of the knowledge management process from creation to use. In most of the process steps, there are already exemplary firms that have made dramatic progress on aspects of knowledge management. In 1995, they are bellwethers; in 2000, their approaches will be commonplace.

Since knowledge is information that is highly valued by people and has



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at some point resided in someone's brain, people are the most important resource in effective knowledge management. In the future as today, firms that excel at knowledge management will corner the market for people who are adept at creating and using knowledge. These people will be evaluated and rewarded for their knowledge activities. Managers will be evaluated not only on how "successful" their decisions were but also on the knowledge used in making them. The most successful firms in the future will make knowledge management every employee's responsibility—not just that of a select few.

Knowledge management in the mid-90s is a matter of economic faith. In the mid-00s (is that what we will call it?), it will be a matter of economic certainty for those who succeed with it. These companies will calculate not only the costs of managing knowledge but also the benefits—in bad decisions averted, in products and services that better meet customer needs, and in wheels not reinvented. Today, the lack of a clear tie to corporate economics is holding back the concept of knowledge management. In the future, at least some firms will have made the connection between knowledge and money.

Several key processes govern how knowledge management works on a day-to-day basis. They include how knowledge is created by or extracted from employees, how it is distributed and accessed, and how it is transferred or lodged in new brains and applied to business problems and decisions. Again, all of these processes are found today in some leading firms; they'll be commonplace tomorrow and highly refined in the firms that have them today.

Knowledge creation is probably best performed today by universities. Whether the field is business or biology, the best creators of knowledge are academics. Consequently, businesses seeking to master this process may form innovative partnerships with universities in which the creation of applied knowledge is outsourced or done collaboratively.

Extracting knowledge that already



"Most people won't have any knowledge, because they could just look everything up in the computer. If all the computers in the world shut down, no one would be able to function and everything would just stop because of people's lack of knowledge."

-NOAH P., AGE 12

exists in the minds of employees is a different type of process for generating knowledge. With no mind-melding on the horizon, future knowledge extractors will focus on rewards for knowledge, hiring good knowledge creators and providing easy-to-use tools for capture. There are also cultural and political barriers to knowledge extraction; I'll share my knowledge with you if you won't steal, misrepresent or misuse it. The firms that are best at extracting knowledge are consultancies, particularly Andersen Consulting and McKinsey. The former emphasizes the use of extraction technology, specifically Lotus Notes; McKinsey & Co. Inc. emphasizes hiring and promoting the right people.

I**N THE ROSY FUTURE** I envision, categorization and organization of knowledge will be a core competence for every firm. This will require strategic thinking about what knowledge is important; development of a knowledge vocabulary (and a thesaurus to accommodate near misses); prolific creation of indices, search tools and navigation aids; and constant refinement and pruning of knowledge categories. Knowledge editors will have to combine sources and add context to transform information into knowledge. In the future, the scarce com-

modity in knowledge management will be attention. No one firm does all these things well today, but the skills to do them are most commonly found among librarians and print journalists. Teltech Corp. does a good job of organizing expert knowledge; Trilogy Development Group organizes product knowledge well.

How do we get the stuff from knowledge repository to knowledge user? Technology plays a big role in this distribution process, of course, and will continue to do so. Firms need to convert from an information push strategy, in which we ship information and knowledge to those who might be interested in them, to a pull strategy. Those who need knowledge must seek it, and someone should be trying to make it easy for them. Hewlett-Packard Co. has a head start on the future in this area; the information design firm InForm Inc. also focuses on information pull.

But knowledge management in the future will involve more than distribution and access. Knowledge transfer means ensuring that someone receives and uses the knowledge in question. Successful knowledge transfer involves neither computers nor documents but rather interactions between people. If you want me to absorb your knowledge, then spend time with me, work with me, do my job and let me do yours. The more time together the better. Who transfers knowledge well today? Sematech Inc. generates knowledge for the entire semiconductor industry and works relentlessly to transfer it, and National Semiconductor Corp. transfers fabrication technology well.

Knowledge management success in the future, then, belongs not to the quick or the technically adept but to the long-term investors and harvesters across multiple fronts. If you want to be good at managing knowledge in the future, now is a good time to start. **CIO**

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1. Are you involved in management or development of World Wide Web utilization at your organization?

☐ Yes ☐ No

2. Which of the following best describes your title within your organization? (Check one only)

- ☐ 1. Webmaster
- ☐ 2. CEO, President, Owner, Partner, General Manager
- ☐ 3. CIO/VP of Information Systems/MIS/DP
- ☐ 4. Dir/Mgr of Information Systems/MIS/DP
- ☐ 5. VP/Dir/Mgr of Networking & Communications Systems
- ☐ 6. CFO/VP/Dir Finance/Controller
- ☐ 7. Consultant
- ☐ 8. VP/Dir/Mgr Accounting
- ☐ 9. VP/Dir/Mgr Engineering/Manufacturing
- ☐ 10. VP/Dir/Mgr Marketing/Sales
- ☐ 11. COO/VP/Dir/Mgr Operations/Administration/Purchasing/Human Resources
- ☐ 99. Other (Please specify) _____

3. What is your primary job function within your organization? (Check one only)

Technical Management

- ☐ 1. Webmaster
- ☐ 2. IS management
- ☐ 3. Networking/LAN management
- ☐ 4. Communications management

Corporate Management

- ☐ 6. Executive management
- ☐ 7. Marketing management
- ☐ 8. Financial management
- ☐ 9. Engineering management
- ☐ 10. Operations management
- ☐ 99. Other (Please specify) _____

4. Which of the following best describes your organization's industry or function? (Check one only)

- ☐ 1. Manufacturer of Computers, Communication or Peripheral Equipment

☐ 2. Manufacturer of other products/processes not included above

- ☐ 3. Finance: Banking
- ☐ 4. Finance: Insurance
- ☐ 5. Finance: Real Estate, Credit or Securities
- ☐ 6. Wholesale or Retail Trade
- ☐ 7. Government: Federal, State or Local
- ☐ 8. Military
- ☐ 9. Transportation: Land, Sea or Air
- ☐ 10. Education: College, University, Library, Secondary, Other
- ☐ 11. Health Care/Pharmaceuticals/Medical Services
- ☐ 12. Utility: Communications
- ☐ 13. Utility: Electric, Gas, Sanitation
- ☐ 14. Accounting or Legal Services
- ☐ 15. Online Product and Service Provider
- ☐ 16. Communications: Publishing, Broadcast, Advertising, Public Relations
- ☐ 17. VAR, VAD, Systems Integrator
- ☐ 18. Computer and Data Processing Services and Software
- ☐ 19. Business Services (other than computer)
- ☐ 20. Research and Development
- ☐ 21. Aerospace/Defense Contractor
- ☐ 22. Mining/Construction/Petroleum/Refining/Agriculture
- ☐ 99. Other (Please specify) _____

5. What is the total number of employees:

(Check one only in each column)

	A.	B.
	In your entire org.	At this location
1. >5000	☐	1. ☐
2. 1001-5000	☐	2. ☐
3. 500-1000	☐	3. ☐
4. <500	☐	4. ☐

6. What are the total annual revenues of your entire organization? (Check one only)

- ☐ 1. Over \$1 Billion
- ☐ 2. \$501 Million to \$1 Billion
- ☐ 3. \$101 to \$500 Million
- ☐ 4. \$25 to \$100 Million
- ☐ 5. Under \$25 Million

7. Approximately how much will your organization spend in the next 12 months on computers, software, equipment and services for World-Wide Web implementation? (Check one only)

- ☐ 1. More than \$1,000,000
- ☐ 2. \$500,000 to \$999,999
- ☐ 3. \$100,000 to \$499,999
- ☐ 4. \$25,000 to 99,999
- ☐ 5. Less than \$25,000

8. In which ways are you/will you be involved in World-Wide Web development at your organization? (Check all that apply)

- ☐ 1. Specify, recommend, or purchase products and services used in Web development
- ☐ 2. Develop Web content and applications
- ☐ 3. Strategic planning of Web projects
- ☐ 4. Manage the Web staff and activities
- ☐ 5. None of the Above

9. Which of the following are currently in use or planned for use in your organization? (Check all that apply)

CLIENT OPERATING SYSTEMS

- ☐ 1. DOS
- ☐ 2. Macintosh
- ☐ 3. MVS
- ☐ 4. OS/2
- ☐ 5. OS/400
- ☐ 6. UNIX (any variety)
- ☐ 7. VM
- ☐ 8. VMS
- ☐ 9. VSE
- ☐ 10. Windows 3.X
- ☐ 11. Windows NT
- ☐ 12. Windows 95
- ☐ 13. Other (Please specify) _____
- ☐ 99. NONE OF THE ABOVE

SERVER/NET OPERATING SYSTEMS

- ☐ 1. Apple
- ☐ 2. Banyan-Vines
- ☐ 4. IBM-LanServer
- ☐ 5. IBM-PC Lan
- ☐ 6. Microsoft-LanManager
- ☐ 7. Novell-Netware
- ☐ 8. Windows NT
- ☐ 9. Other (Please specify) _____
- ☐ 99. NONE OF THE ABOVE

PROTOCOLS

- ☐ 1. TCP/IP
- ☐ 2. OSI
- ☐ 3. SNA(IBM)
- ☐ 4. Appletalk
- ☐ 5. DECNet
- ☐ 6. IPX/SPX (Novell)
- ☐ 7. NetBIOS
- ☐ 8. X.25
- ☐ 9. NFS (Sun)
- ☐ 10. NetView
- ☐ 12. SNMP
- ☐ 13. Other (Please specify) _____
- ☐ 99. NONE OF THE ABOVE

10. Which commercial Internet access providers do you currently use or plan to use in the next 12 months? (Check all that apply)

	A	B
	Currently	Within next 12 months
1. AOL	☐	1. ☐
2. AT&T	☐	2. ☐
3. BBN	☐	3. ☐
4. CompuServe	☐	4. ☐
5. GEIS	☐	5. ☐
6. IBM Global Network	☐	6. ☐
7. MCI	☐	7. ☐
8. Microsoft	☐	8. ☐
9. Netcom	☐	9. ☐
10. Prodigy	☐	10. ☐
11. PSI	☐	11. ☐
12. Sprint	☐	12. ☐
13. U B Networks	☐	13. ☐
14. UUNET	☐	14. ☐
15. Other (Please specify) _____		
99. NONE OF THE ABOVE	☐	99. ☐

(OVER, PLEASE ►►►)

1 Please check below all the products and services that you help acquire, either through approval, planning, recommendation or specification.
(Check all that apply)

COMPUTERS/PERIPHERALS

- ☐ 1. Desktop PCs/Notebooks
- ☐ 2. PC Servers
- ☐ 3. Workstations
- ☐ 4. Unix Servers
- ☐ 5. RISC Server
- ☐ 6. Monitors
- ☐ 7. Printers
- ☐ 8. Storage/Tape Drives
- ☐ 9. CDROM Drives
- ☐ 10. UPS

INTERNETWORKING/LANS

- ☐ 11. Local Area Networks
- ☐ 12. Network Operating Software (NOS)
- ☐ 13. LAN Servers
- ☐ 14. Bridges/Routers/Gateways
- ☐ 15. Intelligent Hubs/Hubs

WIDE AREA NETWORKING/INTERNET ACCESS

- ☐ 16. Modems
- ☐ 17. PCMCIA Modems
- ☐ 18. T-1/T-3 Multiplexers
- ☐ 19. T-1/T-3 Services
- ☐ 20. Fractional T-1 Services
- ☐ 21. Dedicated Lease Lines
- ☐ 22. 56 Kbps Services
- ☐ 23. ISDN Services

SOFTWARE

- ☐ 24. Email/Workgroup
- ☐ 25. Database Servers
- ☐ 26. PC Databases/Front End
- ☐ 27. Communications/Remote Access Software
- ☐ 28. Image/Document Management Software
- ☐ 29. Video Conferencing
- ☐ 30. Multimedia

WEB SOFTWARE

- ☐ 31. Web Browsers
- ☐ 32. HTML Authoring Tools
- ☐ 33. VRML Authoring Tools
- ☐ 34. Web Publishing Tools

- ☐ 35. Search Tools/Engines
- ☐ 36. Encryption Software
- ☐ 37. Firewalls/Security
- ☐ 38. Transaction Processing
- ☐ 39. Consulting Services
- ☐ 40. Outsourcing
- ☐ 41. Other (Please specify) _____

- ☐ 99. NONE OF THE ABOVE

2 Which of the following publications do you receive addressed to you personally?
(Check all that apply)

- | | |
|--|--------------------------------------|
| ☐ 1. Interactive Age | ☐ 4. NetGuide |
| ☐ 2. Interactive Week | ☐ 5. WebWeek |
| ☐ 3. Internet World | ☐ 6. Wired |

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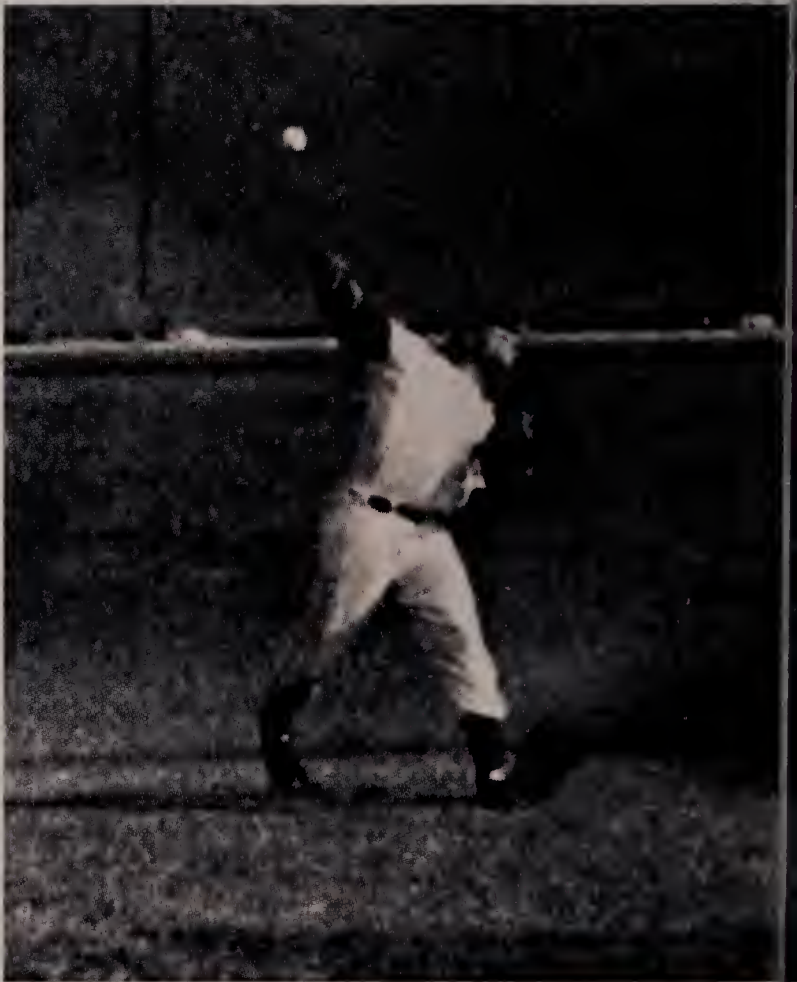
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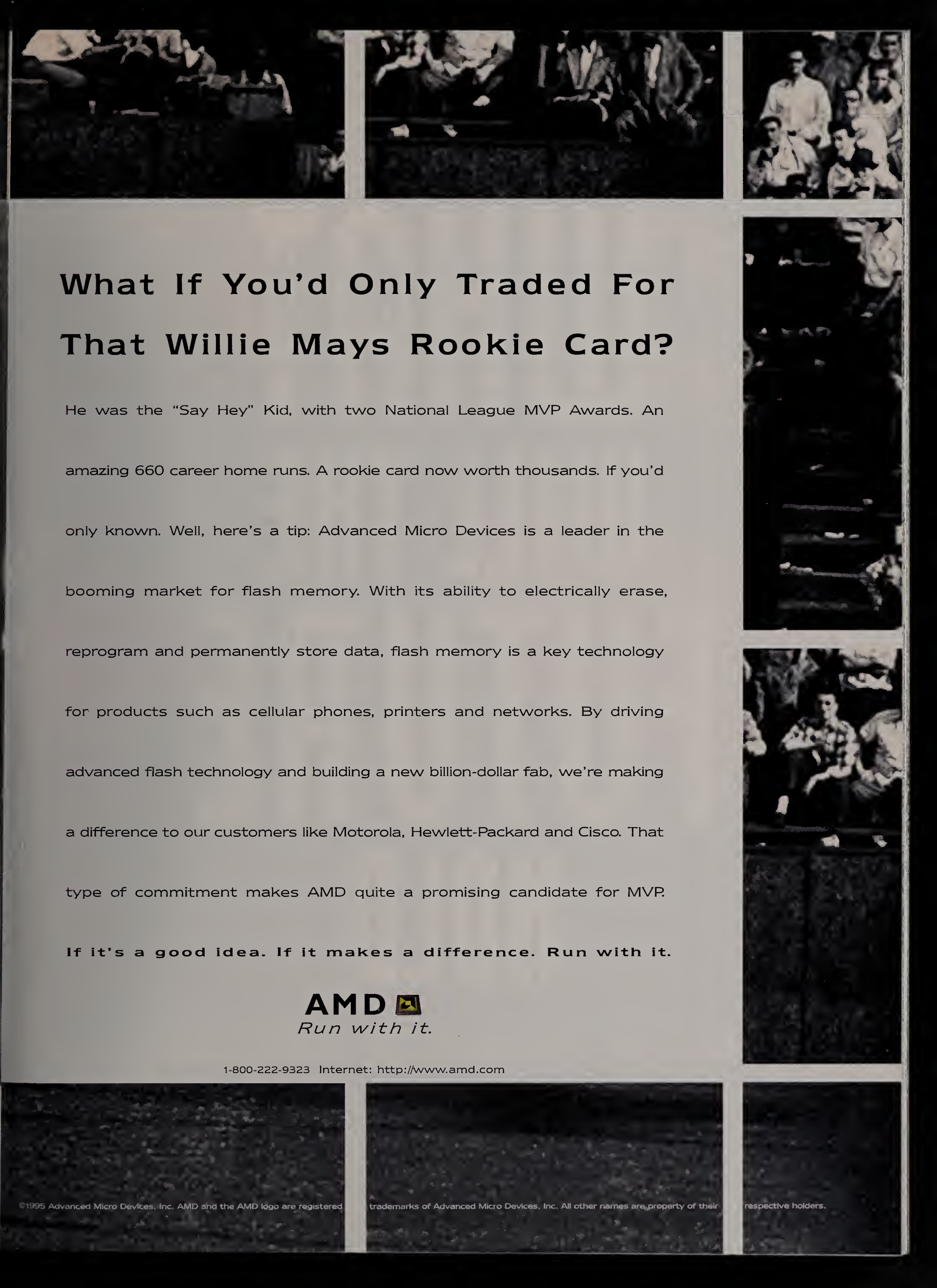
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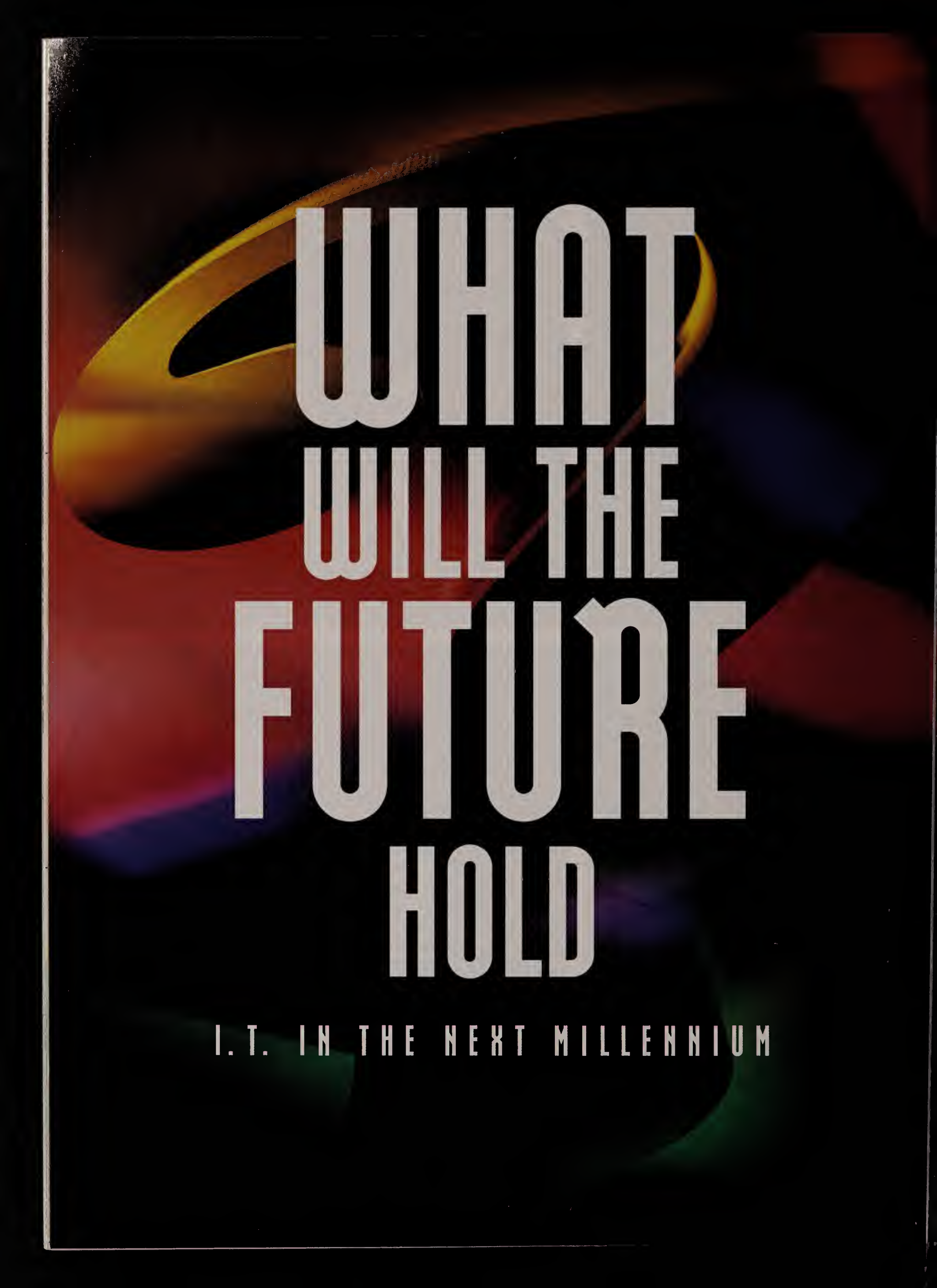
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WHAT WILL THE FUTURE HOLD

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strained your eyes to see; now it's something you stumble over while racing from one innovation to the next. It took over a century for the Industrial Revolution to reach the United States after the invention of the steam engine by Scotsman James Watt. But the transformations caused by advances in information and communications technologies are happening almost as soon as we

can imagine them. And with the Internet and the World Wide Web, geography sets no limits on where innovation can happen or where its effects will be felt.

This is cause for great excitement, and great fear. Think of the Industrial Revolution giving rise to sophisticated national and international transportation systems, which in turn gave rise to the suburbs and the great urban centers. Now try to imagine the potential impact of a global information infrastructure dissolving the miles between those cities and suburbs such that the movement of things becomes secondary to the movement of ideas. The possibilities are beyond our ken.

In putting together this issue of *CIO*, we concluded that—considering the pace with which technology is driving change—15 years out was about as far as we could look. For that reason (and figuring that most of our readers will probably still care about this stuff in 2010, even after they've all been appointed CEO or found new life as the creator of some high-tech startup), we restricted ourselves to that time frame.

While much about the future is speculative, some things are clear. For instance, just about everything and everybody will be connected, and there will be a lot more intelligence going around—whether you're talking knowledge workers collaborating globally or smart devices communicating with each other and with people. When you can imbed a computer chip into practically anything for as little as \$2, the possibilities are limitless. In fact, says MIT's Michael Schrage, there will be such an abundance of "computational riches" that we'll place a higher value on tools and techniques that provide constraints than on those that offer greater informational opportunities.

What's also clear is that some companies are going to find it hard to keep up. "The corporate graveyard will be strewn with the bodies of companies that don't understand how to make the

shift," says Schrage in our futurists' panel, beginning on Page 42. "Many of them will be the leaders of the old because leaders of the old often have the most difficulty embracing the new."

DURING THE MONTHS that we worked on this project, we tapped into the thoughts of business and technology visionaries and explored some Pretty Big Issues. And as we mulled over the material we had gathered, we started to wonder what the next generation might have to say about all this. To find out, Associate Editor Alice Dragoon went to the Michael Driscoll School in Brookline, Mass., and asked members of a fourth-grade and two seventh-grade classes to imagine themselves in the year 2010 and to consider the following questions: What is your office or your job like, and how is it different from the way things were in 1995? If you were starting a company, what kind of company would it be? What is the most exciting thing about the future and why? What is the scariest thing about the future and why? Computer Specialist Ann Koufman and fourth-grade teacher Marcy Prager oversaw the project.

The students' comments were so compelling that we decided to make them the unifying element for the entire issue. These kids not only know what is happening in technology and the world around them, they are also thinking—hard—about the implications of these trends. They wonder if virtual connections will promote actual isolation, and they're concerned with issues of privacy and overpopulation. They also have some great ideas for new products and services. You'll find their thoughts sprinkled throughout the articles contained herein.

If you enjoy this special issue of *CIO* magazine, please visit our Web site at <http://www.cio.com/CIO> for more about what the future has in store.

—Abbie Lundberg, Editor

"By 2010, I'm sure we will already be very changed, and it's frightening."

—DAPHNE P., AGE 12

"I think people make much too big a deal about the future."

—ANNA S., AGE 12

WHAT WILL THE FUTURE HOLD

"The Earth will get too crowded because there will be some medicine to make you live longer. Maybe people won't even die. If that happened, you might have to live on another planet. I would hate that because of these questions: What would we eat? Would I get split up from my family? Would there be strange creatures? All of these things would make me terrified. I hope this never will happen in the future."

—RORY B., AGE 9

FUTURISTS' PANEL

The Yellow Brick Road

We may not know what lies at the end of this path we're on, but one thing's for sure—this definitely isn't Kansas anymore

AS WE PEER INTO THE FUTURE, what do we see? A hazy picture in which technology amplifies the good and bad changes it already has wrought. New products will make life interesting, faster paced and maybe even a little simpler. Companies will have easy access to more market information than ever; consumers will select from an increasingly large and customizable palette of options. Many companies will

fail, and new ones will rise quickly to take their place. Information will flow, but privacy will be shattered. New freedoms will arise, and unheard-of restrictions will be imposed. To get at the heart of some of these issues, *CIO* Contributing Writer Lynda Radosevich asked a panel of leading business thinkers to address changes that are likely to occur within the next 10 or 15 years.

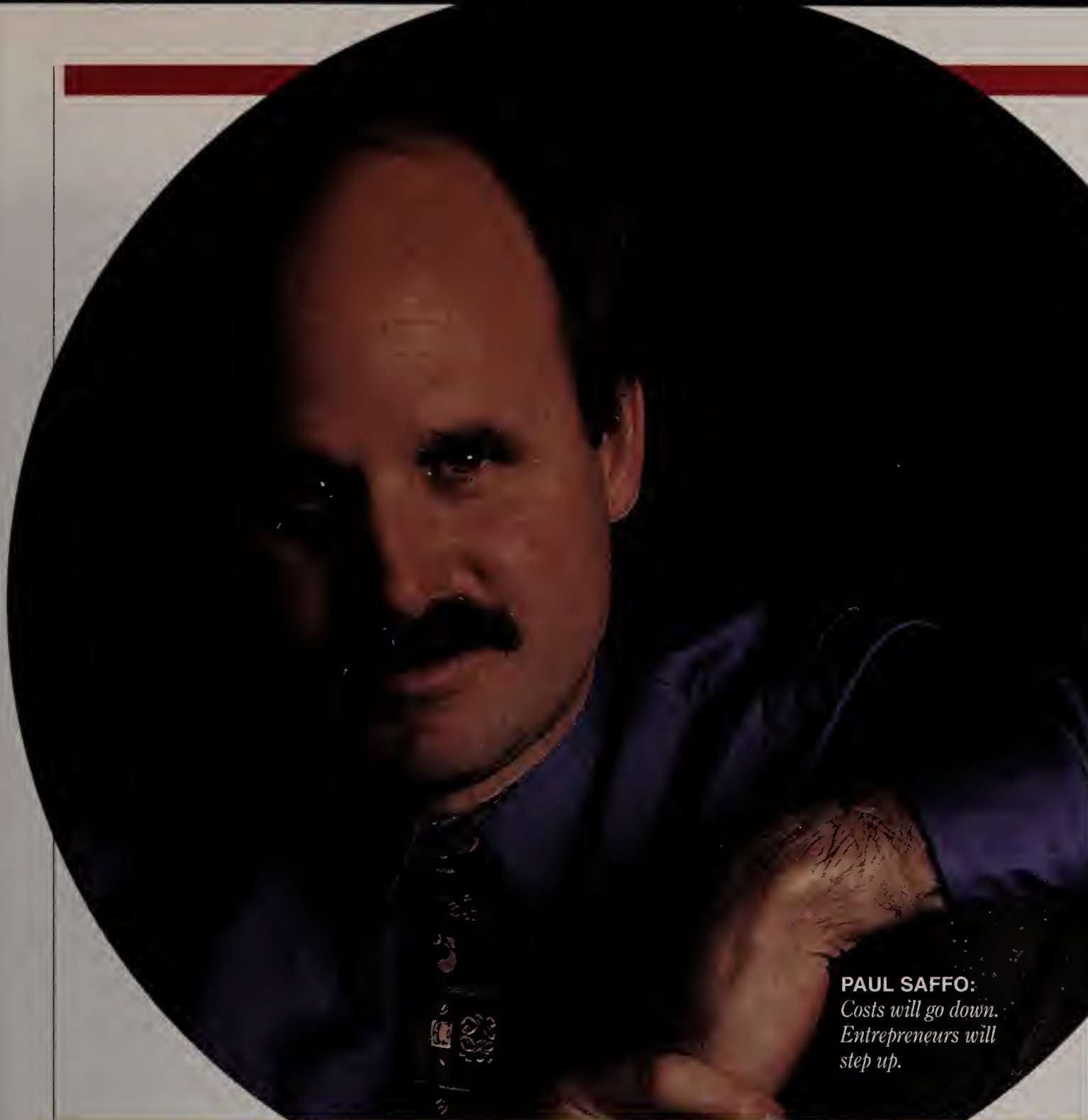
Paul Saffo *is a renowned futurist and a director at The Institute for the Future, a Menlo Park, Calif., think tank.*

INEXPENSIVE MICROPROCESSORS shaped the 1980s. The 1990s were shaped by inexpensive lasers, which led to disk-based multimedia and fiber-optic telecommunications. The third shift, made possible by stuff like MEMS [MicroElectrical Mechanical Systems] technology, will be about giving our devices eyes and ears.

Cheap sensors will lead into a world of "smartifacts": intelligent artifacts that

know the world around them. This stuff is so cheap that it will invite whimsical uses. You can get TV cameras today that are slightly larger than a walnut and cost a few tens of dollars. Well, combine them with MBone on the Internet and you could have cameras looking at traffic at all the major intersections in a city. You could set up a little agent in your Internet browser in the morning to monitor traffic flows by scanning those cameras. You can almost do this today in California. Caltrans has a Web page map of San Diego that reads the sensors in real-time off the freeways and reports traffic speeds [see "The Highway Patrol," *CIO*, Dec. 1, 1995]. Or maybe you'll capture the data and use a modified H.261 [video compression/decompression] wireless standard to get medium-resolution video images sent to a handheld video monitor in your car. Devices capable of doing this exist today.

After sensor technology, it'll be wireless. Wireless has intrinsic limitations—one fiber-optic strand has more bandwidth than the entire radio spectrum. So it won't



PAUL SAFFO:
*Costs will go down.
Entrepreneurs will
step up.*

“In 1995, people did not have nuclear-powered computers like in 2010. There were no robot cars or electromagnetic floppy disks. There were no computer chips to insert in your skull. The world did not have artificial food creators or home gene slicers.”

—ANDREW S., AGE 9

Get ready for a world of “smart” items: hard goods that sense what you need and help you get it. Boxes that can tell you what’s in them. New products that will lead to...

be using radio to the exclusion of fiber or traditional cable, but maybe it’ll be short hop radio, the last 100 feet somewhere. PCS [personal communications service] is just a microcell cellular system. The moment it goes digital, you can do all sorts of interesting things with it.

For instance, imbed a cheap sensor into the box carrying a stereo system that’s being delivered. The last thing the Federal Express guy does before he delivers it is use his little handheld device and wireless technology to poll the chip in what’s now a smart box and say, “Did you get handled badly?” The smart box says, “No siree, Bob.

Nobody dropped me.”

These are just random ideas, and they’re not very exciting ones, but in 10 to 20 years, when this stuff is cheap, entrepreneurs with

MORE BANDWIDTH doesn’t mean better communication. I can pick up this phone and I can call Paris, France. I can call anywhere in the world. But the fact that I don’t speak French sort of reduces the value of that for me. —MICHAEL SCHRAGE

shoestring budgets and little adult supervision are going to come up with great ideas for it.





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The IBM Global Network lets Wedgwood keep its master craftspeople working together in Britain, while still servicing customers in cities and towns in seventy countries.

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"Cars would drive themselves. There would be no car accidents of any kind. Cars could fly, swim and drive over snow and sand. You would have to select which way you wanted to travel, and the car would obey. Also, cars wouldn't pollute because we would have found some other way to propel them."

-ANNA S., AGE 12



ELECTRONIC COMMERCE is at least two years away from takeoff. Details still have to get worked out: encryption systems that really work, standards for digital cash and all that. Then it's going to follow a diffusion curve. Parts of it will happen quickly, and other parts will be astonishingly slow to happen even though it makes perfect sense.

-PAUL SAFFO

We will be able to directly determine the rate at which customers acquire these services, the types of customers, their rate of usage, etc. In addition, we will be able to diagnose the customer's vehicle while it's be-

...new ways of listening to the market and letting consumers pick from ever-more customized services and products, which in turn provide instant feedback until...

Vincent Barabba is general manager of the General Motors Strategic Decision Center and author of *Meeting of the Minds: Creating the Market-Based Enterprise* (Harvard Business School Press, 1995).

IN THE NEAR FUTURE, companies will be able to listen to customers online more than they have in the past. In GM's case, we can use mobile positioning satellite technology and such to provide customized services. For example, you could activate a service that would alert the closest emergency vehicle if you were in an accident and the airbag were deployed. Or, if you were lost and you had a navigation system in your vehicle, there's no reason why we couldn't pinpoint where you were relative to where you wanted to go. The nice thing about technology is that you could build the enabling capability within every vehicle but just activate the features for which the customer is willing to pay.



VINCENT BARABBA:
We'll help in an emergency. We'll help when you're lost.

ing driven. The customer sends a message to a central location, which sends back a diagnosis. That's good for customers because they know what's going on in their cars without having to go into the repair station. It's good for us because we're now capturing the knowledge of what's happening to our vehicles while they're being used.

Today's technology is capable of performing many of these services. The key issue is designing the capability into the design and manufacturing process and building the sales volumes that make these services more affordable. You'll see some of these things before next year is over. The question is how fast will you see them generally applied. I don't think anyone has a correct answer to that yet, but it's certainly before the end of the century.

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"The walls will be screens so that you can see whatever's going on anywhere. They will also be your windows, since real windows will be useless, except to show you the devastation."

—ANNA S., AGE 12



WE DON'T KNOW what's going to happen in the future, because it is partly up to our choices.

—RICHARD STALLMAN



REAL ADVANCEMENT will be in how we apply technology we already have to run our business. There is so much technology already out there that's not being used as effectively as it could be. Look at all the data mining tools. Yet we have very little in the way of management thinking that can apply those tools, mainly because the technology's moving faster than our ability to understand it. —VINCENT BARABBA

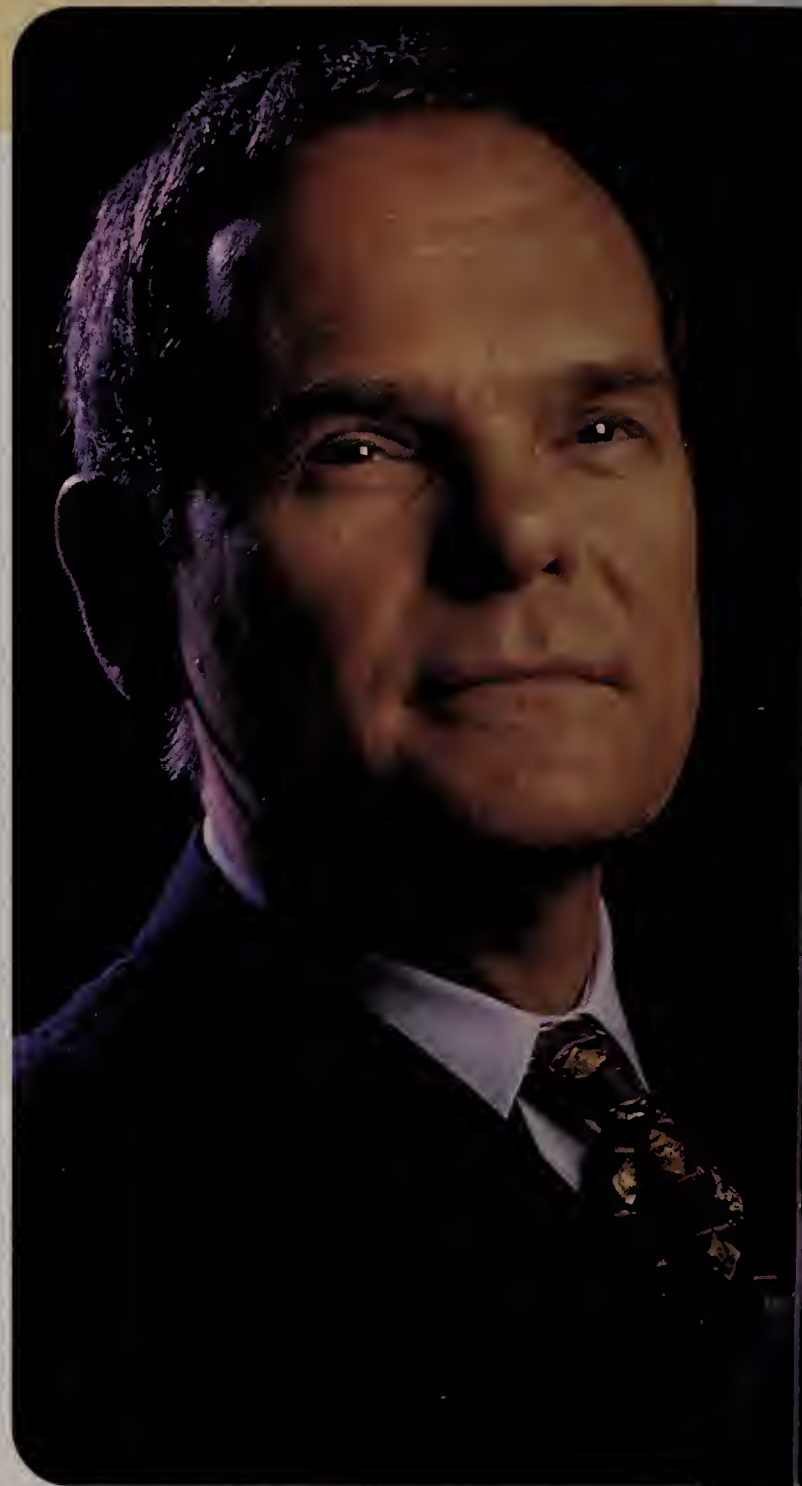
new economy, which is based on knowledge, much work is serendipitous, ad hoc, communicative, brainstorming, innovation-oriented

...market cycles shrink to the point that even real-time response isn't good enough. To survive in a digital economy, organizations will have to anticipate how to adapt themselves and change before the market does....

Don Tapscott is president of New Paradigm Learning Corp. in Toronto, the author of *The Digital Economy: Promise and Peril in the Age of Networked Intelligence* (McGraw-Hill, 1996), co-author of the best-selling *Paradigm Shift* and chair of the Alliance for Converging Technologies.

WITH THE SHIFT to a digital economy, the old corporation is being disaggregated. It's being replaced by dynamic molecules and clusters of molecules, or individuals and entities, and these really form the basis of economic activity. The nature of the new internetworked business is as different from today's command-and-control hierarchical corporation as it was from the feudal craft shop. It requires a radical rethinking of the nature and functioning of the organization and the relationships between organizations.

As we move into a digital economy, we must develop a new approach to changing our businesses for success. Reengineering will be inadequate because it typically results in structured business processes. But in the



effort that doesn't lend itself well to structured processes. Organizations will have to create the tools and the environment whereby people can apply their human ingenuity across geographical and time boundaries to make breakthroughs in wealth creation.

In creating this new organization, the person at the top can't necessarily learn for the organization as a whole. Things are becoming too complicated. People are not just cogs in a process; they're human beings and they

have needs that go beyond business processes. High-performance companies will design work systems where people have whole jobs and where they're highly motivated.

One example today hints at the organizational changes of the highly digitized future. Encyclopaedia Britannica was the number-

one encyclopedia company for 217 years. Last year it fell behind Microsoft and Grolier. This is not because people bought CDs rather than encyclopedias. It's because computer companies like Compaq bundled a CD to boost computer sales. This dramatically changed the perceived value of a physical encyclopedia while it introduced people to the idea of a multimedia encyclopedia. Now [since early 1994] Britannica is boldly attempting to leapfrog the others by putting Britannica on the Net. You have a digital, hot-linked encyclopedia. When you enter it, it tells you how to subscribe. What was a book became a subscription, but it's now gone beyond that to become a directory to all human information. It changed from a physical to a digital distribution channel. It changed its market from individuals to institutions. And it changed its entire organizational structure to correspond to a new economy, which is digital.

The corporate graveyard will be strewn with the bodies of companies that don't understand how to make this shift. Many of

DON TAPSCOTT: *Tools must enable people to exploit their own ingenuity.*



ORGANIZATIONS RESEMBLE the communications networks they rely on to do business. In the telegraph and postal service age of the 1800s, companies had star-shaped structures. Then we had command-and-control hierarchies, which looked a lot like phone networks. With the Internet, it's a whole different sort of beast: a web-based company. The right metaphors are biologic, and the corporation structure as we know it will not exist 20 years from now. -PAUL SAFFO

them will be the leaders of the old because leaders of the old often have the most difficulty embracing the new, and success and momentum in the old model often become your inertia in the new. Machiavellian, vested interests fight the change. But we're moving into a period where the shakeout will happen very rapidly.

...Companies will use information technology to facilitate the complex interrelationships between people. This will enable them to tap individuals' creative abilities and, in some cases, modify their behavior....

"The thing that I find the most scary is not knowing what they will discover next."

-BECKY T., AGE 12



“Anybody
can find out
everything about
you with a few
clicks of their
mouse. I don’t
want anybody to
know anything
about me unless
I tell them.”

—SHIRA G., AGE 12



MICHAEL SCHRAGE:
*We are starting to focus
on a collaborative infra-
structure.*

Michael Schrage is a research associate with the MIT Sloan School and the MIT Media Lab, and author of *No More Teams! Mastering the Dynamics of Creative Collaboration* (Doubleday Currency, 1995).

BANDWIDTH AND PROCESSING cycles are going to be fundamentally free as we move into the future. Now, that means you have an embarrassment of computational riches, and the values are going to be on the constraints rather than on the opportunities. What you decline to do is going to become more important than what you do.

If you look at individuals, we are deluged with information every waking moment. Thermal information, visual cues, acoustic cues, but we have nervous systems that fil-

PRIVACY is not just an ethical or social issue; it is a business issue. Companies need to protect the privacy of their employees and customers or face the coming firestorm in the marketplace. —DON TAPSCOTT

ter things out. Larger organizations are going to be doing that as well. They’re going to be spending more time filtering, managing and discriminating than exploiting.

There are three stages of information technologies. In the first stage, the design

philosophy was distribution and transmission. The question was, “We have technology and information; how do we distribute it?” Or, “If we have a network, how do we transmit it?” It was a point-to-multipoint distribution issue. In the second stage, with the rise of the Internet, peer-to-peer networks and client/server, we have the notion of sharing information.

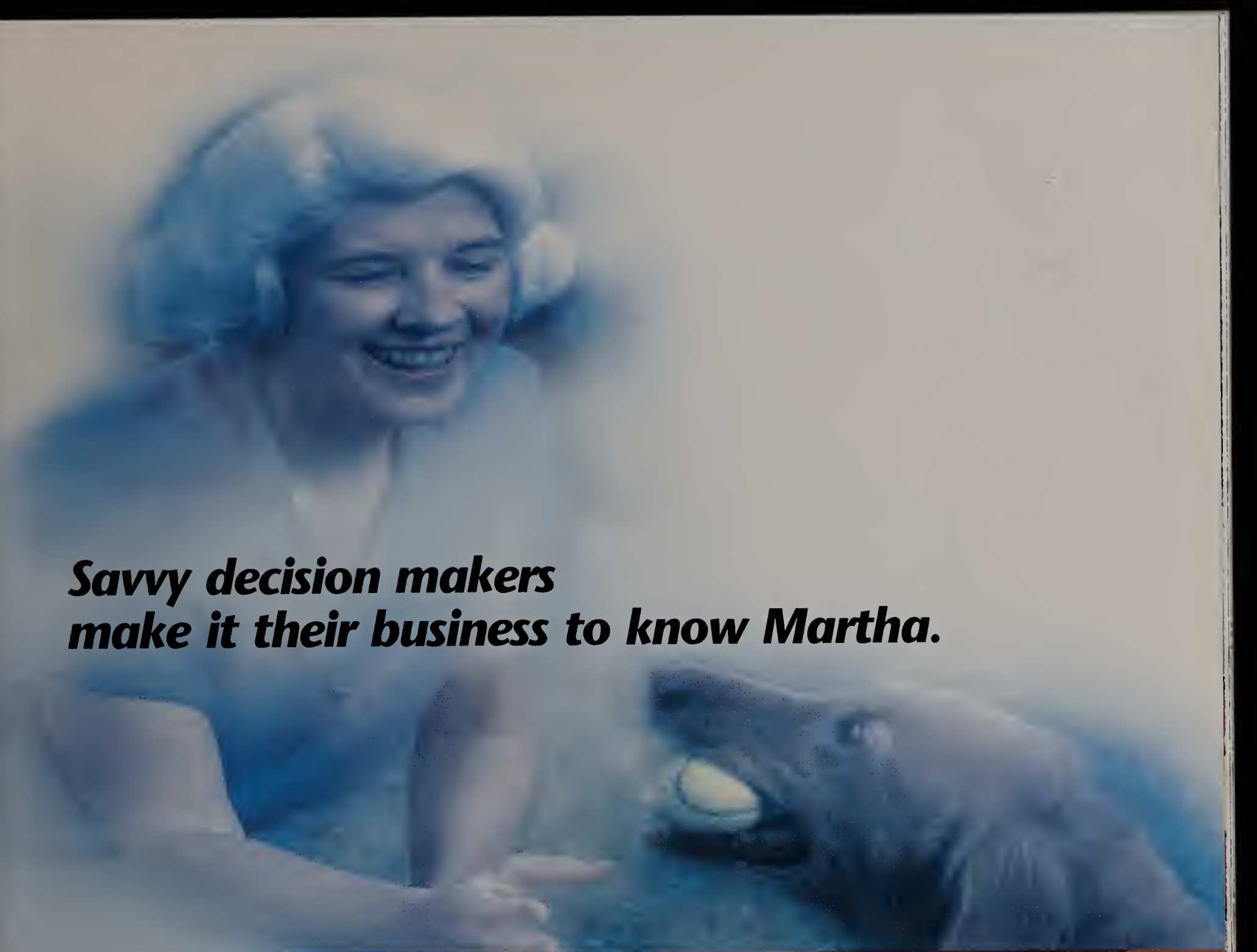
We are in the beginning of the next phase: using technology as a vehicle to help create ideas, concepts and models with other people. We’re moving from the notion of, “Here’s my information, what do you think?” to “How do we collaborate and work together to create shared models, shared representations that we could not create on our own?” It’s about interactive relationships as opposed to distributional or just sharing relationships.

Collaborative infrastructure enables people to create things in real-time and asynchronously with other people. To make a crude analogy, it’s what happens when we get three or four people all holding pieces of chalk in front of a blackboard. Or we get four or five people all surrounding an industrial design prototype, a model of some particular product.

The challenge that we’re facing as we scale up our networks is how do we scale up our collaborations, interactions, accordingly. It’s easy to scale up distributional technologies. It’s not even that difficult to scale up sharing infrastructures (although any Lotus Notes administrator will tell you it’s not that easy). But to scale up our collaborative infrastructures is going to be very, very tough.

As much as I am a champion of collaborative creativity, I’m not saying it will be valued above all else. It shouldn’t be. It exists in the context of what the organization is trying to do. In many organizations, the smartest people will run the company and will use technologies to extend their span of control. These technologies will become a medium for autocracy. We will now know who did what when, and we will run our company accordingly. Many companies will use these technologies to further consolidate and centralize the power at the top, and people who do exceptions will be monitored, audited, punished and rewarded accordingly.





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—Bloor Research, Parallel Database Report, 10/95

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—Bloor Research, Parallel Database Report, 10/95

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Relational OLAP	First Shipped Q4'95	Proprietary OLAP

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"I would start a candy company. I could use computers for storing data, making graphs of my sales, incomes, etc., and advertising on the World Wide Web. I could teleport candy to my customers around the world, and it wouldn't take days to get to them."

—SHIRA G., AGE 12



...From among the changes will emerge new ways of creating and acquiring technology. As did the Internet in the past 20 years, software and systems will grow and proliferate outside the proprietary mainstream.

Richard Stallman *founded the Free Software Foundation in Cambridge, Mass., and received a John D. and Catherine T. MacArthur Foundation Fellowship for his programming genius.*

SOFTWARE FREEDOM means no restrictions on copying and modifying programs. Users can access the source code in order to modify it for their own needs. Although proprietary software won't go away, free software is gaining acceptance in the corporate world as people see the success of free programs such as Web browsers.

I can see a number of ways that free software authors could be funded: by taking commissions to make improvements or by teaching classes in how to use the software or make improvements. I made a living that way for several years, and then I got a fellowship and I didn't have to anymore.

Another way is to form groups where users pitch in to support software development. Suppose there are people who like video games where the characters punch and kick each other. There could be the street-fighting video game of the month club, where all the money that we receive, less administrative overhead, will be spent on programmers trying to write better characters for punch-and-kick video games. And if you want to see more of such, please join us. The an-

THE WAY WE DELIVER IT will change. Much of what we do now will be done by the publicly available infrastructure. It won't be just outsourcing but something much more profound. It's the creation of a whole new platform upon which to transform the enterprise. —DON TAPSCOTT

nual membership is \$50, and we estimate that for every 1,000 members, there'll be one new game.

This method very much lends itself to

business applications. There could be the travel agent software improvement club that travel agents would belong to, and it would improve airline reservation software. You would find that the more successful businesses would join because they would want the improved software yesterday. They'll say, "We'll save so much on it that it's worth joining to make it get done faster." And the unsuccessful businesses will say, "Well, gee, we would use this improved software, but right now we're struggling to stay afloat; therefore we won't join." And that'll be OK. After all, you don't need everyone to pay to fund the development.

Up Close and Personal

In the future, people may need to meet less, but they may want to more

PAUL SAFFO: We're headed into a future of more travel, not less. In 20 years, we will cross the country with the same sort of casualness currently reserved for the Boston to New York shuttle. And we will cross the oceans in the same way we cross the country today. The more we communicate electronically, the more we desire to meet face to face. If you're talking regularly to someone in Singapore, inevitably you'll say, "Let's get together sometime." And the more you meet face to face, the more you want to continue the conversation electronically between meetings. I looked at the last 100 years of travel and communication statistics, and it's clear: Both go up in tandem.

DON TAPSCOTT: Yes, I agree. There is, however, evidence of a substitution effect in



RICHARD STALLMAN:
*Free software authors must
be supported.*

There's a tendency to presume that commercial software will work better. Practical experiments show that this isn't true. In fact, a year ago somebody did a scientific experiment. He took several comparable sets of programs, one of which was the GNU programs [a Free Software Foundation project that is developing a complete software environment including operating system kernel and utilities, editor, compiler and debugger], and the others were commercial. He tested them all by feeding them random input, and measured how often he observed a problem: Either the program failed to terminate or it crashed. And the most reliable of all were the GNU programs, which are free. Now there's a reason for this. With GNU programs, we get bug reports from people saying, "I was reading the source of the program, and I saw what looks like a bug. And here's what I think is the right fix." Commercial developers don't and won't get that. **CIO**

a number of specific areas. For example, the new collaborative technologies of workgroup computing are enabling distributed teams to function together in ways previously unanticipated, thus reducing the need for travel. Technologies integrated across an organization and extended out among organizations have connected individuals who can then function together as a team. Although part of such disbursement involves travel substitution, part of this is enabling communications that couldn't occur even with travel.

As these new global relationships are forged on the network, certain destinations will become even more inviting. If young family members spend time visiting the San Diego Zoo through CD-ROM, interest in actually visiting the zoo and seeing the animals live is intensified. The search for authenticity will drive tourism in the future.

VINCENT BARABBA: Collaboration means to work together—especially in a joint intellectual effort. Although the question of whether technology will encourage us to travel more or less makes for interesting speculation (par-

ticularly for us in the transportation business), the key question is whether technology will help us improve how we collaborate to seek superior answers to

the vexing questions we all face—whether we're in the same place or not. This will require those who are working on ways to minimize the interpersonal issues of decision making to get together with those who can provide technological support for their efforts. Also, the technology doesn't have to be very sophisticated to provide value. Sometimes, just providing an instant (while everyone is still available) and clear statement (what was actually said) and getting agreement that what is written is agreed to by everyone participating is a major step forward. Obviously, more sophisticated applications that lead to new ideas, conflict resolution and consensus building can be of even greater value.

—L. Radosevich

CHANGE IS ENABLED by technology, but technology is not a driving force. We could elect to not change anything at all if we wanted to. —PAUL SAFFO



“Everything will be automatic, and people will use computers to express how they feel instead of talking to a friend or someone who understands.”

—MEREDITH H.,
AGE 9



You're on the road. With a client.



You need to locate a bottle design.



HQ's database has 40,000 bottles.

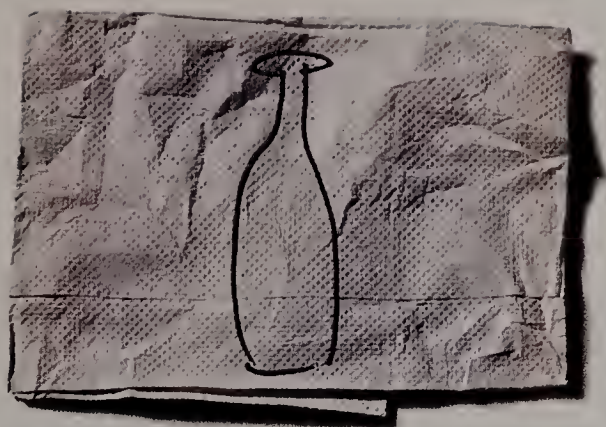


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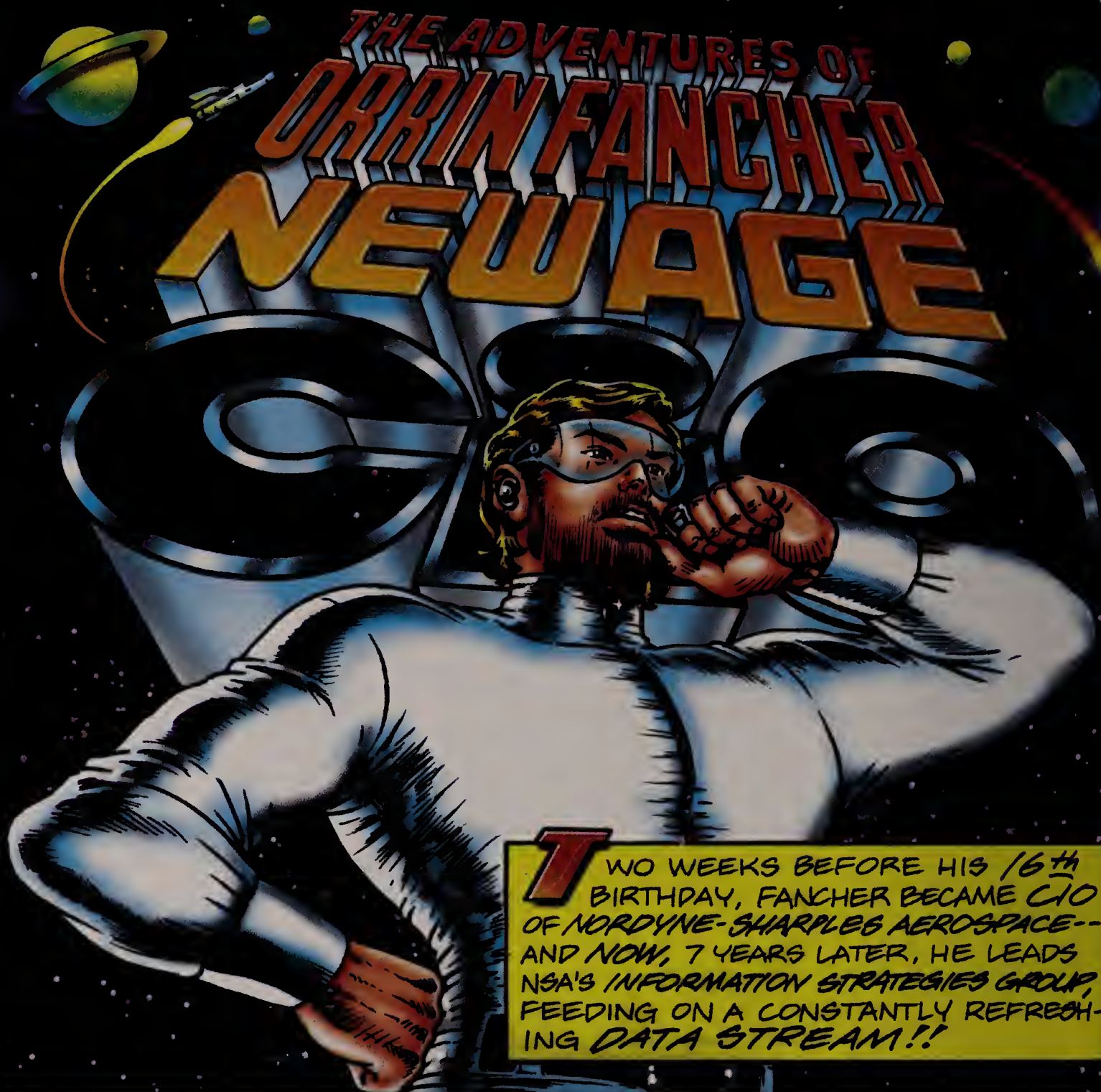
WHAT WILL THE FUTURE HOLD

“People won’t realize that they’re losing what they once had. They won’t remember what other things you can do besides sit at a computer all day. People today have good lives and do stuff like play on basketball teams, but later in time, people will just sit and do nothing all day.”

—EMMA T., AGE 9

“The future could be great if you get a good job or the future could be bad if you don’t get a job.”

—CLARA B., AGE 9



TWO WEEKS BEFORE HIS 16TH BIRTHDAY, FANCHER BECAME CIO OF NORDYNE-SHARPLES AEROSPACE-- AND NOW, 7 YEARS LATER, HE LEADS NSA'S INFORMATION STRATEGIES GROUP, FEEDING ON A CONSTANTLY REFRESHING DATA STREAM!!

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FICTION BY LEW MCCREARY

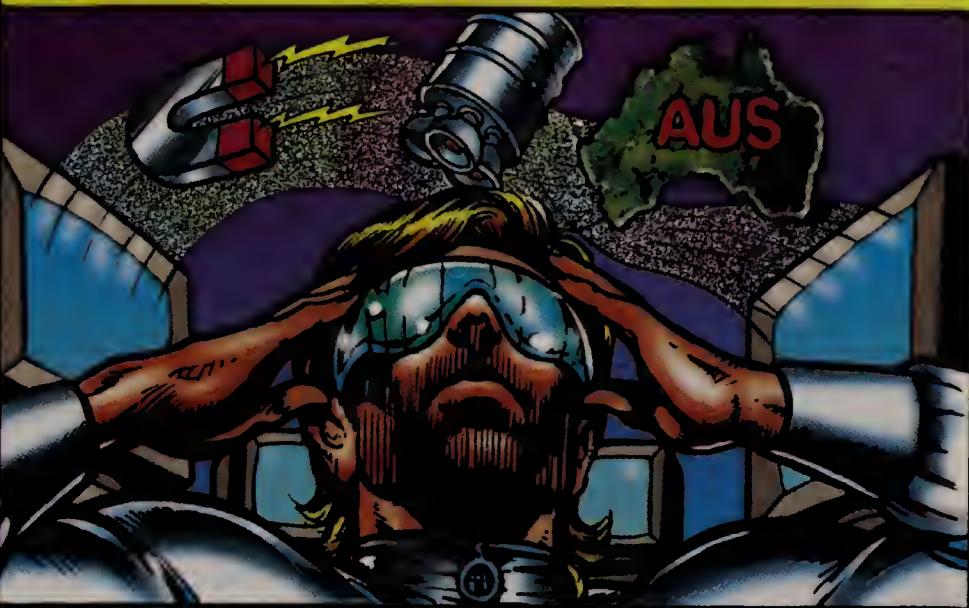
FOR YEARS, ORRIN FANCHER FEARED he might never live down the inevitable celebrity that came with being the world’s youngest CIO. Colleagues and strangers alike called him “Doogie” (after *Doogie Howser, M.D.*, a popular television show about a teenage physician that aired in the late 1980s and early 1990s).

Fancher, who received his Harvard MBA at the tender age of 13, became CIO of Norcross Propulsion Systems (now Nordyne-Sharples

IN HIS HIGH-TECH OFFICE, FANCHER PREPARES TO ENTER THE INTERNAL NSA WEBSITE!



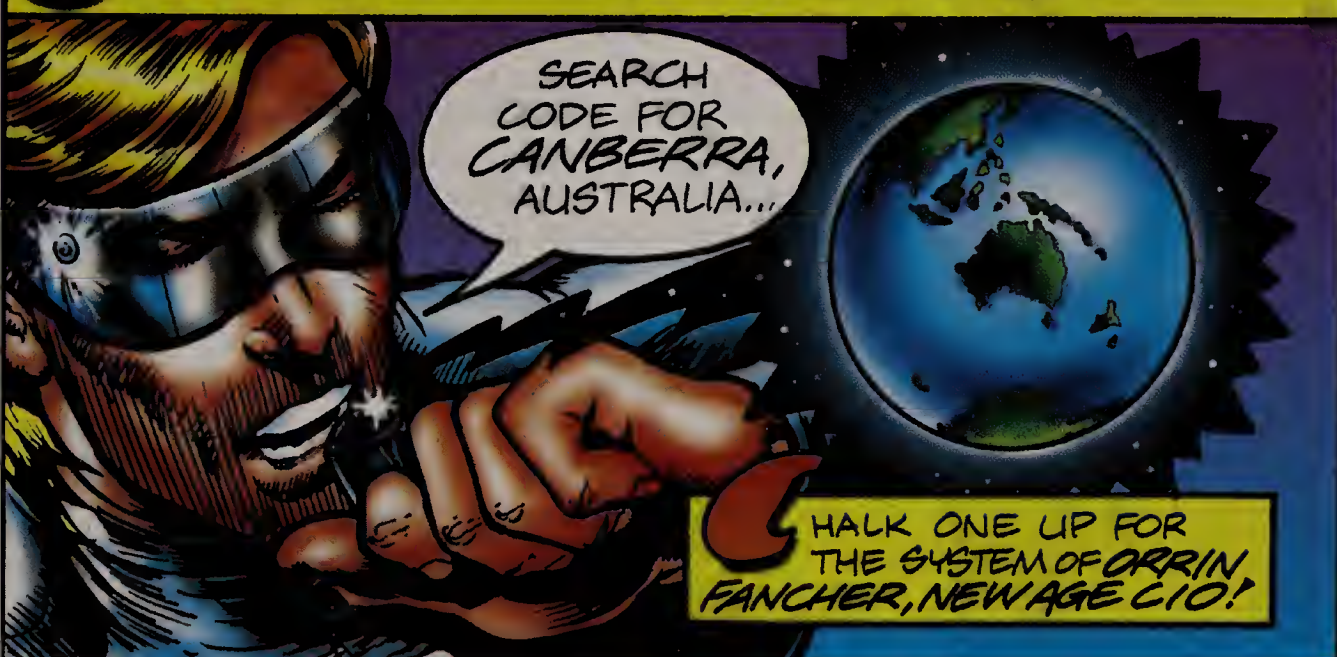
STREAMS OF VISUAL INFORMATION-- CALLED JAVA FLOWS-- ERUPT FROM THE MIDST OF TEXTUAL CONTENT!



BUT SUDDENLY...



SPEAKING INTO A MOTOROLA WORKGROUP COMMUNICATOR, FANCHER CAN CONTACT NSA LOCATIONS WORLDWIDE!



Aerospace, or NSA) in August 1998, "two weeks before my 16th birthday" (see "Young Guns," *CIO*, Dec. 1, 1998).

But Fancher was only the leading edge of a wave. Today, at 23, he is just one of many youthful CIOs who have put their companies at the forefront of the game-based decision-support revolution. He has led NSA's Information Strategies Group through a period of rich mutation, culminating in the rollout of Shadow Business, the full, custom-built VR simulation environment that resembles nothing so much as the Holo-deck of the Starship Enterprise (see "Let's Pretend We're a Business," *CIO*, June 15, 2004).

"Game theory has always been my specialty," Fancher says. "I believe that anyone should be able to 'play' the business and test hypotheses in a realistic way. Shadow Business is real enough to scare the crap out of someone who tries out a flawed hypothesis—or to exhilarate someone who gets one right."

Indeed, the highs and lows of elation and devastation to which the executive "players" are subject, depending on the success or failure of their stratagems, require ever-deeper layers of HR support in the workplace: peer counseling teams, sensory-deprivation nap rooms, antidepressant dietary regimes in the corporate cafe, arrays of sportslike coaching kiosks—positioned near restrooms and throughout the parking lots—that either caution the triumphant against smugness or stiffen the spines of the recently demoralized.

"The hard thing has been to get the culture comfortable with risk," Fancher says. "Even though it's only a simulation and no lasting harm results, people are just so scared to be wrong. It's an aerospace company, remember. I mean, what's the margin of error on a contract bid? What's the margin for error on an engine design? The failure metrics die hard. Even in a game."

But within NSA itself, Fancher's own grand design continues to be dogged by

Orrin Fancher claims not to worry much about the possible negative social consequences of computer-aided uncertainty.



Fancher wears a Motorola Workgroup Communicator that keeps him in constant contact with between three and seven NSA locations around the world. He whispers to the uplink band on the knuckle of his left index finger and then stares at the floor while nodding over the whispered replies of his scattered colleagues.

outbreaks of controversy. (Even the gushing post-test-drive testimonial delivered by President Gates when he and that renowned virtuality zealot, Vice President Gingrich, visited NSA on a campaign swing last fall, was scant insulation from dissenting opinion.) No less an eminence than Don Sharples Jr., heir-apparent to retiring Sharples founder Don Sr., was quoted in the Aug. 23, 2005, *Fortune* magazine saying that he hoped "executives were spending as much time *doing* business as they were *playing* at doing business."

SO IT ISN'T SURPRISING that in the course of a typical day, Orrin Fancher can pretty much count on at least one meeting in which the ROI of Shadow Business is a hot topic; indeed, the various real-time decision-support metrics that attempt to gauge the qualitative contributions of Shadow Business to the *real* business are so complex and costly that they, too, must be defended with their own ROI metrics. Fancher himself concedes, "It does get a little bit circular."

But circularity is a familiar orientation for someone, like Fancher, whose belief system feeds on a constantly refreshed data stream. On the particular, allegedly typical, recent day when *CIO* accompanied Fancher on his rounds of meetings and "mappings" (the name he gives to his own methodology for acquiring information about what NSA is doing in both the real and virtual universes), he was wearing a Motorola Workgroup Communicator that kept him in constant contact with between three and seven NSA locations around the world. From time to time he would stop and whisper to the uplink band on the knuckle of his left index finger and then stare at the floor while nodding over the whispered replies of his scattered colleagues. ("Protocolwise, it's imperative to whisper," he says of the Motorola units. "That way you can always tell that it's someone coming in remotely through the ear implant. Otherwise you might get confused and think it was someone in your physical space.")

Fancher prizes the ability to have multiple conversations and "overhearings" virtually around the clock. "Hey, I'm 23 years old; I'm unmarried; I live by myself. I *could* turn the implant off when I sleep, but I choose not to. At a time in my life when I don't especially need or want much private space, I can remain fully interruptible."

(Editor's Note: *During the preparation of*

this story, author McCreary had access to Fancher on a 7-by-24 basis through the implant. McCreary reports that it was "pretty disconcerting" during one insomniac night "to be able to whisper a request for clarification to a guy who was fast asleep 1,500 miles away. The next morning I had an e-mailed answer waiting in my queue.")

THE INFORMATION Strategies Group at NSA has some of the feel of a modern street gang. In fact, few of the members are much older than Fancher, and most of them go around dressed in the casual urban street style of loose-fitting Mylar disposables, which have the added info-age virtue being easily chippable—pressure-sensitive Intel function patches can turn a shiny black coverall into an application or performance upgrade ("With traditional cotton-polyesters, the chips don't stick as well," says Fancher). What is striking about the physical layout of NSA's inner campus is that it has yet to be overtaken by the vogue for deskless open spaces. (See "Requiem for the Desktop," *CIO*, May 1, 2004.) While people do tend to wander ruminatively through the Information Strategies Group workzone as though they had no place to sit, there are abundant two-walled workstations with enough idiosyncratic adornment to suggest habitation by sole individuals.

"Call us old-fashioned," laughs Fancher's Chief Architecture Officer Dory Cray, "but there's actually been a hotelling backlash here. We did it in spades a few years ago, but we found that people require a more durable sense of place or else they begin to forget their job descriptions. Forgetting turns out to be a big problem in contextless workspaces. This applies to the physical and logical infrastructures alike."

So, says Cray, one of her challenges in planning and manipulating the technology architecture is to see where IT can "fortify context by strengthening the communication links among team members." Still, she says, "we find we have to leave at least some space for personalness."

Fancher himself often passes a night of contextless sleep in one of the ISG nap rooms, and on the morning of *CIO*'s visit, his commute amounts to two lefts and a right along a few short segments of corridor. His own office resembles a small conversation pit buttressed with computer-topped pediments that give the space a Stonehengely feel. When he arrives there,

the first thing he does is enter the internal NSA Webpace. He summons together the relevant icons for a status debriefing, clicking up pages of decision points that have migrated from the simulation realm into the action realm.

"The Webpace is a great tool for tracking the thoughts that propel a consensus movement. We try to capture as much of the prop wash of people's concerted energies as we can so that Shadow Business will have additional ways of recognizing the likenesses among the various decision sets over time. Everything that people think or feel about a given problem is usable data in terms of helping Shadow Business learn about who we are and how we behave. Even gossip is important. Or maybe what someone has done to her hair." As he scrolls through the pages, streams of visual information—so-called Java flows—erupt from the midst of textual content, giving attributable human support to decision trails. Fancher, while occasionally whispering to unseen colleagues ever on-call via his knuckle, saves some of the status information into a single Oracle compression file that will, in turn, sort, edit and save important data to Fancher's various master databases.

"Now, for my daily descent into administrative and regulatory hell," he says.

It is the responsibility of ISG to configure the daily workforce; day layoffs and rehiring are decreed by the "workplan" component of Shadow Business overnight and downloaded into the HR database for morning implementation. That means the HR webmaster will have had to post the Daily Employee Exception Lists (or DEELs) on the Webpace in time to enable workers to prepare either for coming to work that day or for unemployment. ISG must channel the relevant employee numbers to the Bureau of Labor Statistics (see "Who's Got a Job Today?" *CIO*, Sept. 15, 2002).

Fancher claims not to worry much about the possible negative social consequences of computer-aided uncertainty. "The fact that someone might not necessarily know from day to day whether he or she has a job to go to is a pretty well accepted fact of employment life by now," he says. "People are really adaptable. I mean, what's so bad if they wake up and check the [Webpace] and see they're free that day? They can do errands or take a V-trip, or whatever. A lot of people think this amounts to inadvertent so-

cial engineering, whereby daily exceptions are necessary just to give people a chance to manage their nonwork duties better."

ISG is also charged with forwarding a number of other database updates to various government authorities, including one that monitors employee e-mail for possible terrorist content. "Like all businesses, we struggle to keep up with our anti-crime obligations," says Fancher. "The continuing burden of the Militias Regulatory Act [of 1998] alone adds something like \$2 million annually to our security budget. But since we do some weapons work, NSA's compliance profile is probably a lot more stringent than for other businesses."

AS FANCHER CONCLUDES the uploads, Cray comes to get him for a preliminary context-gathering meeting with the principals of a product-design team planning a simulation run. The run is in preparation for a project to design Emergency Movable Homes (EMHs)—permanent dwellings intended for home sites in high-risk flood plains, barrier beaches and other disaster-prone areas that, when danger threatens, can literally be driven off their foundations in sections and moved to designated refuge areas. "These EMHs aren't going to be mobile homes in the usual sense," says Cray. "They'll be real houses. It's just that they'll have this extra added dimension."

"A dimension," says Fancher, "that will please the hell out of property-casualty insurance companies and FEMA."

The meeting is cordial and efficient. The voice of Shadow Business itself moderates the session (the voice sounding like an impossibly ambitious meld of races, genders and nationalities—both inoffensively unrecognizable and yet exotic), asking a jumble of context questions in an apparently random order.

"Who are the customers?" asks the voice. "What are the likely materials?" "Do we have identified alliance partners?" "Are the deadlines adjustable?" "What is the market size?" "How is the force of movement applied?" "Are the street infrastructures adequate for transporting houses?" "Do we have manufacturing capacity in place?" "How many subcontractors are required?"

Fancher spends a lot of knuckle time during this meeting, presumably because it is wholly uncontentious and thus requires



Most Information Strategies Group members dress in the casual urban street style of loose-fitting Mylar disposables, which have the added info-age virtue being easily chipable—pressure-sensitive Intel function patches can turn a shiny black coverall into an application or performance upgrade.



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Computer Systems



It is the responsibility of ISG to configure the daily workforce; day layoffs and rehiring are decreed by the "workplan" component of Shadow Business overnight and downloaded into the HR database for morning implementation.

less than his full attention. Eventually, Shadow Business declares itself satisfied with the foundation of basic context that the meeting participants have provided.

"Thank you. You may go now," it says in its omni-dialected voice. The congregants file out as though they are not completely sure why they've been dismissed at this particular moment—as opposed to five minutes before or an hour hence.

"People don't always understand what the system is getting at," Fancher says. "Its interests are expressed in a nonlinear, non-relational way. And since most of us are accustomed to assembling ideas in coherent thematic strings, it throws us off our guard to be interrogated by non sequitur."

Asked what he thinks of movable dwellings as a business opportunity for NSA, Fancher shrugs. "Who knows? I mean, why would anyone want to live in a place that called for such precautions? I'm such a fan of virtual reality. I could live inside a shoe and still have any experience I wanted. I think there simply ought to be more—and more varied—kinds of movable environments. A house, and its location, would sort of not matter all that much.

"But I was raised to virtuality," he adds. "And I recognize that that's unusual still. It certainly defines a cultural rift in NSA and most other companies—this line between devotees of the physical and those who think it's OK to put your faith in information that isn't actuality-driven. I mean, look at digital cash. There's still this ingrained reluctance to use the stuff, and it's been around more than a decade. My own net worth is in gigabytes. Period. And no harm done, I might add. So, why is everyone still waiting for catastrophe?"

BY EARLY AFTERNOON, Cray and Bill Wyzantski, NSA's director of benchmarking compliance, are on a gleeful midlevel security alert after detecting an unwanted crawler incursion into the NSA Webpace's benchmarking warehouse. "It's a pretty big problem for us," says Wyzantski, a former interactive-games designer. "Lots of people want in, but they don't all want to ask permission first. So they try the back door." While he won't acknowledge this, the speed and ease with which Wyzantski's tiger technology discovered the intruder suggest some doors are deliberately left open at NSA.

"He's trapped," says Cray, placing her

finger on a small phosphor of hot yellow light deep within a pattern of indigo whorls on the screen.

"Uh-huh," says Wyzantski. "Let's erase and reply." The process empties the crawler of any purloined content and returns an e-mail to the sending party that explains the proper procedure for requesting NSA's help in any benchmarking study. "This enforcement protocol can be done automatically, of course," says Wyzantski. "But, hey, we all like to drive sometimes." He raises his eyebrows. "That's one of the bad things about the games model—you're often tempted to play when it might be a heck of a lot more efficient to be off doing something else. You're constantly having to make the prioritization call."

But Fancher, obviously sensitive to the scrutiny to which his championed model falls prey, simply grumbles that "we're all adults here."

"Everyone but you," says Cray.

Fancher ignores the remark, whispers into his knuckle and soon nods avidly over whatever he is being told. Once the conversation wraps up, he turns to Cray and says, "Chalk one up for the system." When pressed to elaborate, he explains that NSA is "testing a magnet-based rocket-propulsion system in Canberra, Australia, next week. And Shadow Business says the test is gonna fail because the dust particles in Canberra are a factor finer than the gauge of the screening membranes designed to keep the magnet surfaces free of contamination."

"Wow," says Cray.

"So, tell me," Fancher says. "What is the [expletive] ROI of *that*? Where the hell is [NSA CEO] Donald Senior today? I've got to find Don Senior..." And so he crouches down, assuming a hunched-over shape of self-contained concentration, and begins to whisper search codes into the flexible channels of NSA's secured communications web, trying to find the near or distant node that will turn out to be his eternally grateful boss, Donald Sharples Sr.

"Dust," he says. "Virtual dust. So fine you can't even see it." **CIO**

Lew McCreary is the editor in chief and publisher of WebMaster (the bimonthly supplement to CIO) as well as consulting editor of CIO. No stranger to fiction writing, he is also the author of the novel The Minus Man, published by Penguin Books. He can be reached at mcreary@cio.com.

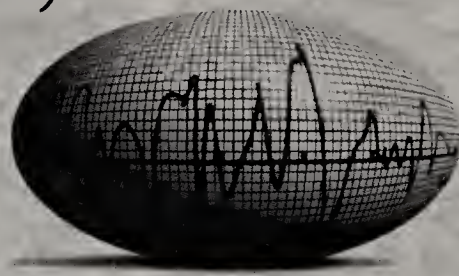
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WHAT
WILL THE
FUTURE
HOLD

"The best thing about the future is that you can pass on the generations of memories that you carry to the next generation and maybe the one after that. Maybe they can learn without experience. Maybe they'll be the ones to make everything all better."

—ANNA S., AGE 12

TELECOMPUTING

Going the Distance

Technology pioneers experiment with faster, cheaper ways to deliver data, text, graphics, sound and video. Some innovations will change the ways we live; others will go the way of the 8-track tape deck. But all will serve as milestones on the road to the 21st century. **BY ANNE STUART**

TELECOMPUTING, AS A MEDIUM of human communication, will rank right up there with the invention of the alphabet, the printing press, the telephone, the television and the PC itself, according to some futurists. In fact, business and technology visionaries predict that history ultimately may deem this networked intelligence the most significant development of all because it creates such vast, unimaginable opportunity.

Why, just 15 short years ago, the concept of eliminating the barriers of time and distance seemed hopelessly futuristic, borrowed from an Isaac Asimov novel or an episode of *Star Trek*. Today, telecomputing is revolutionizing a variety of fields, including medicine, education, government, banking and media, to name a few. The evolving merger of telephone, computer and video technology allows people to work, quite literally, in two places at once.

Through two-way videoconferencing, for example, a physician in Lubbock, Texas, can examine the medical records of an inmate at a maximum-security prison 120 miles away. And thanks to the Internet, a single mother in Cleveland can earn an MBA from the University of

Phoenix without ever setting foot in Arizona. In fact, a growing number of companies exist primarily, some even entirely, in cyberspace.

As it turns out, these "telefields" are not new concepts. Correspondence courses, first delivered by mail and much later by TV, date back to the late 19th century, and physicians experimented with "distance medicine" as early as the 1950s. What is new, however, is the improvement in accessibility—cheaper, more effective technologies that allow more organizations to make more services available to more people—and the wider social acceptance of those technologies.

Not too long ago, such arrangements were accompanied by suspicion and the admonition that the quality of the virtual



KATHY CRUZ: *From the beginning, the VeriFone strategy has been to have the employees close to the customer.*

experience would fall short of the real thing. Beyond that, some critics today remain wary of telecomputing, citing as their reason the productivity paradox—the idea that corporations have invested billions of dollars in IT in the past decade, while productivity gains haven't kept pace. Others, including Howard F. Didsbury, director of special studies at the Bethesda, Md.-based World Future Society, predict that telecomputing and related technologies will soon eliminate more jobs than they create.

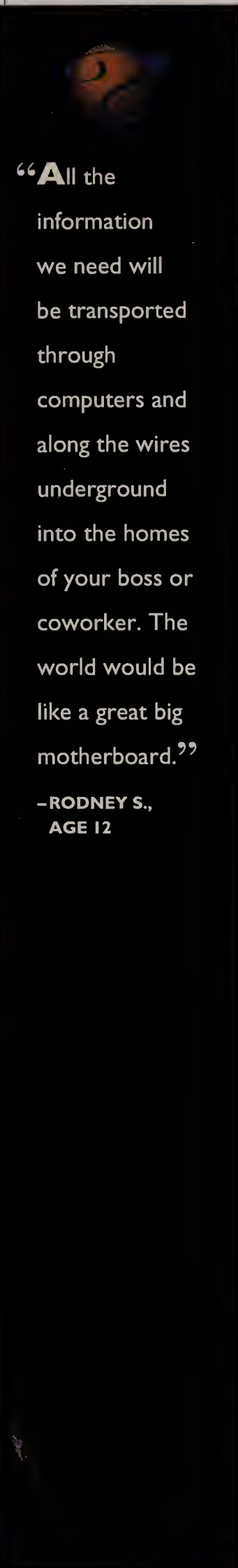
Proponents, on the other hand, point to the opportunities brought about by telecomputing—the specialized medical care or lifelong education—and the savings in employee travel or building maintenance. They contend that telecomputing will, in fact, create jobs: Several of the 20 careers highlighted in *U.S. News & World Report's*

recent “hot job” listing involve computer networking, including positions for webmasters, online content developers and wireless-device salespeople. However, even telecomputing's most ardent proponents don't expect the distance model to replace face-to-face contact in any profession, at least not anytime soon. After all, despite the availability of telecommuting and teleshopping, the vast majority of us still go to the office and the mall.

And while there's no consensus on the precise combination of technologies that will eventually support the evolving global information network, futurists agree that it will do more than tie technologies together. The information superhighway will serve as the backbone of the new “knowledge economy,” just as railroads, expressways and the utility power grid provided the

“In the future, I am going to be working on repairing satellites while living in the space station that is currently being built. I will start a vacation company in space, and you could take a vacation on the moon.”

—MATTHEW W.,
AGE 12



“All the information we need will be transported through computers and along the wires underground into the homes of your boss or coworker. The world would be like a great big motherboard.”

**—RODNEY S.,
AGE 12**

infrastructure for the American industrial economy.

One thing is certain: The emerging technologies and evolving philosophies about how people share information will continue to create new ways to learn and conduct business in the coming century.

THE VIRTUAL OFFICE: TELEWORK

THINK OF IT AS a desk-free job. For some pioneering companies, the 21st century workplace goes beyond telecommuting, in which some employees work from home. Those organizations have discovered “telework”—headquarters that consist primarily of mobile workers who are equipped with the best available computers and telecommunications devices. While workers may occasionally meet in person or by videoconference, they spend the bulk of their time working independently somewhere else. Some companies may actually have no physical headquarters, existing only in cyberspace.

Underlying the technology is a highly collaborative environment that encourages employees to share their knowledge and skills with their suppliers, customers and clients, as well as their supervisors and colleagues. That was the philosophy behind the organizational structure at VeriFone, which manufactures transaction-automation equipment. Founded in 1981 in Hawaii, the company didn’t officially have a primary office until the Securities and Exchange Commission required it to establish one when the company went public.

“The founders knew that the strategy they wanted to employ was to have the employees close to the customer. That was from the first day, and it has driven the infrastructure,” says Kathy Cruz, VeriFone’s vice president for MIS. “It’s an incredible solution; you have employees where you need them rather than where your building is. If you need people in Florida, you put them there because the infrastructure can support them there, rather than in California because that’s where your building is.”

Most employees travel constantly, conducting business by portable computer. “Your office is your notebook and where you hook up,” says Cruz, who visits her Redwood City, Calif., office only a few days

every month. Employee files and most office forms—purchase orders, budget data, vacation requests, hiring paperwork—exist only online. Even a new employee’s technological orientation happens online. A few weeks after joining the company, every VeriFone employee worldwide gets an introduction to the company’s system, conducted by telephone and collaborative computing. “We use a technique that allows the student to maneuver through the system while the instructor watches,” Cruz explains. The instructor has trained about 200 employees in 29 locations around the world without ever leaving her home in Philadelphia.

Later, VeriFone’s more than 2,200 employees can improve their skills through the company’s continuing education program, the Virtual University. VeriFone employees also stay in touch through an in-house news service (“a virtual water cooler,” as Cruz puts it), a video magazine, pagers, voice mail, e-mail, its World Wide Web page, teleconferencing and videoconferencing.

Cruz predicts that virtual reality will come into play eventually. But even with all that technology, managers and employees occasionally gather in person. “You cannot go indefinitely without the face-to-face contact,” Cruz says.

While projections call for telecommuter ranks to reach 10 million by the year 2000, no one can reliably estimate how many companies “telework” in the same way that VeriFone does. Recognizing that the virtual workplace isn’t for everyone, VeriFone carefully screens its employees. Those who like sharing workspace and lunching with fellow workers every day probably wouldn’t make the cut. Still, as more companies go global and rely increasingly on doing business electronically, it’s reasonable to assume that the lifestyle of the VeriFone employee lifestyle will become increasingly common. Because they exist only in cyberspace, virtual companies rely even more heavily on streamlined, constantly upgraded technology than do their real-world counterparts. As Cruz puts it: “The network is the heartbeat of the company.”

But making sure that everything runs smoothly is only half of IS’s job. “In addition to knowing the technology, the CIO of the future really has to be able to vision in a way that is different from before,” Cruz says. And there’s no online substitute for knowledge, communication and dedication.

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As Ronald K. Goodenow, director of the telework initiative at the Institute for Policy and Social Science Research at the University of New Hampshire in Durham, N.H., puts it: "These systems are not going to work unless people are really committed to what they're doing."

THE VIRTUAL CLASSROOM: DISTANCE EDUCATION

USING THE CompuServe online service, students in Manchester, N.H., or Montpelier, Vt., can earn a master's degree in journalism from the University of Memphis without ever venturing south of New England. Internet newcomers can learn their way around the global network in courses offered by e-mail. And no matter where they live, high-tech professionals can test their knowledge of technology on IBM's World Wide Web site in a New York suburb or up-

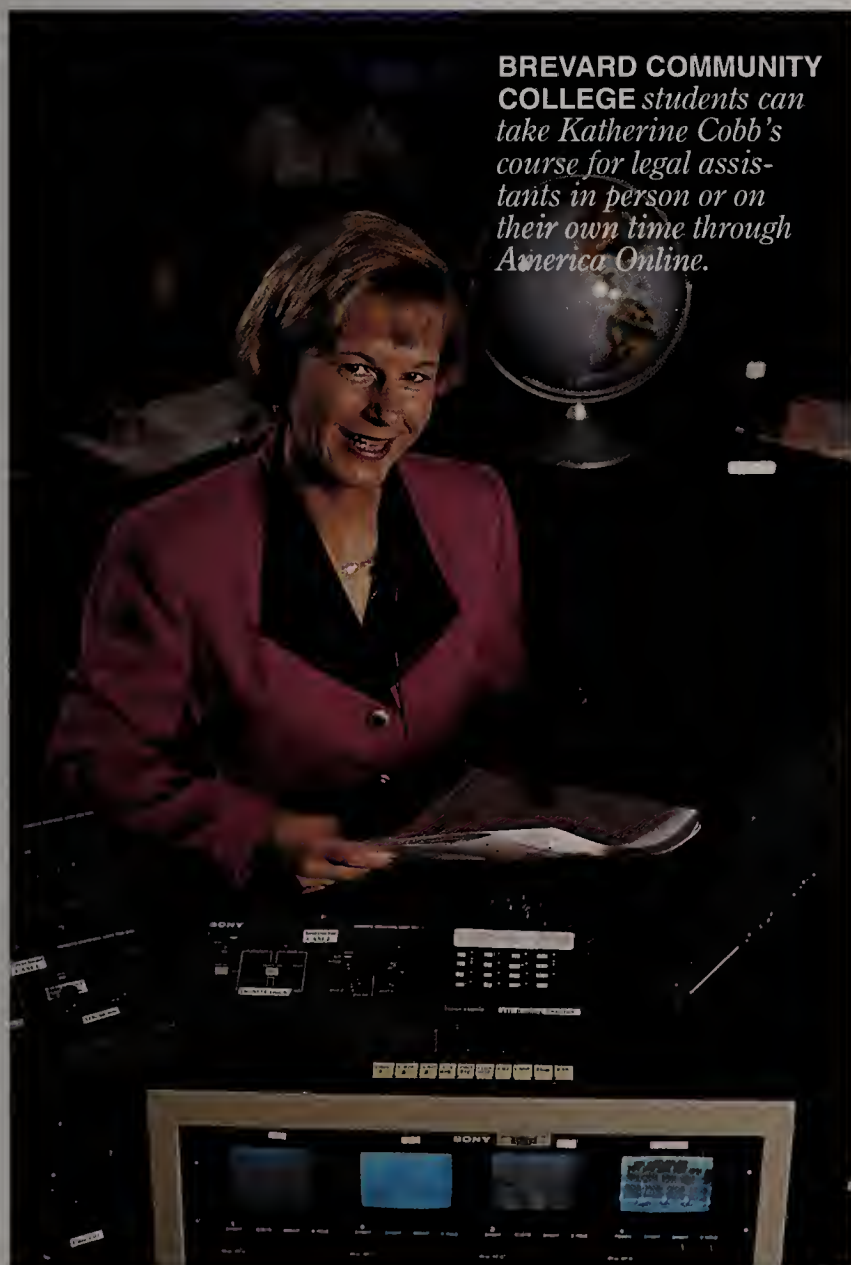
grade their skills through courses offered by the Redmond, Wash.-based Microsoft Online Institute.

The virtual classroom eliminates the barriers of geography. However, distance education typically doesn't require all the participants to communicate at the same time. That's especially important, given the target audience for the coming decade. "In the year 2000, the majority of students will be over 25 years old," says Jacques Dubois, director of distance learning at Brevard Community College (BCC) in Cocoa, Fla., which has just begun offering courses leading to associate's degrees through its new World Community College on America Online. "People in that age bracket are busy consumers, and they want to take courses at their convenience." They also tend to be technologically savvy and committed to upgrading their skills throughout their careers. In addition, advocates say, the virtual classroom makes courses available to the handicapped, workers on irregular shifts, frequent travelers, single parents, residents

of isolated areas or people who want to study in a highly specialized area—such as BCC's alternative-energy program—without requiring them to move closer to campus.

While distance education can still involve mailed materials, TV or video courses, the hottest growth area is online education, which lets people dial in from the desktop at work, the computer at home or the laptop on the road. No one can reliably estimate how many colleges, universities, vocational schools and other programs offer online classes or other forms of distance learning. But the Distance Education and Training Council in Washington estimates that about 3 million students are registered this year in council-accredited programs in 200 subject areas, ranging from accounting to zookeeping. Both credit and noncredit offerings are on the rise, but full-degree programs remain relatively rare. According to a recent study of 230 colleges by the American Association of State Colleges and Universities, half the schools surveyed offer "cybercourses," but

BREVARD COMMUNITY COLLEGE students can take Katherine Cobb's course for legal assistants in person or on their own time through America Online.



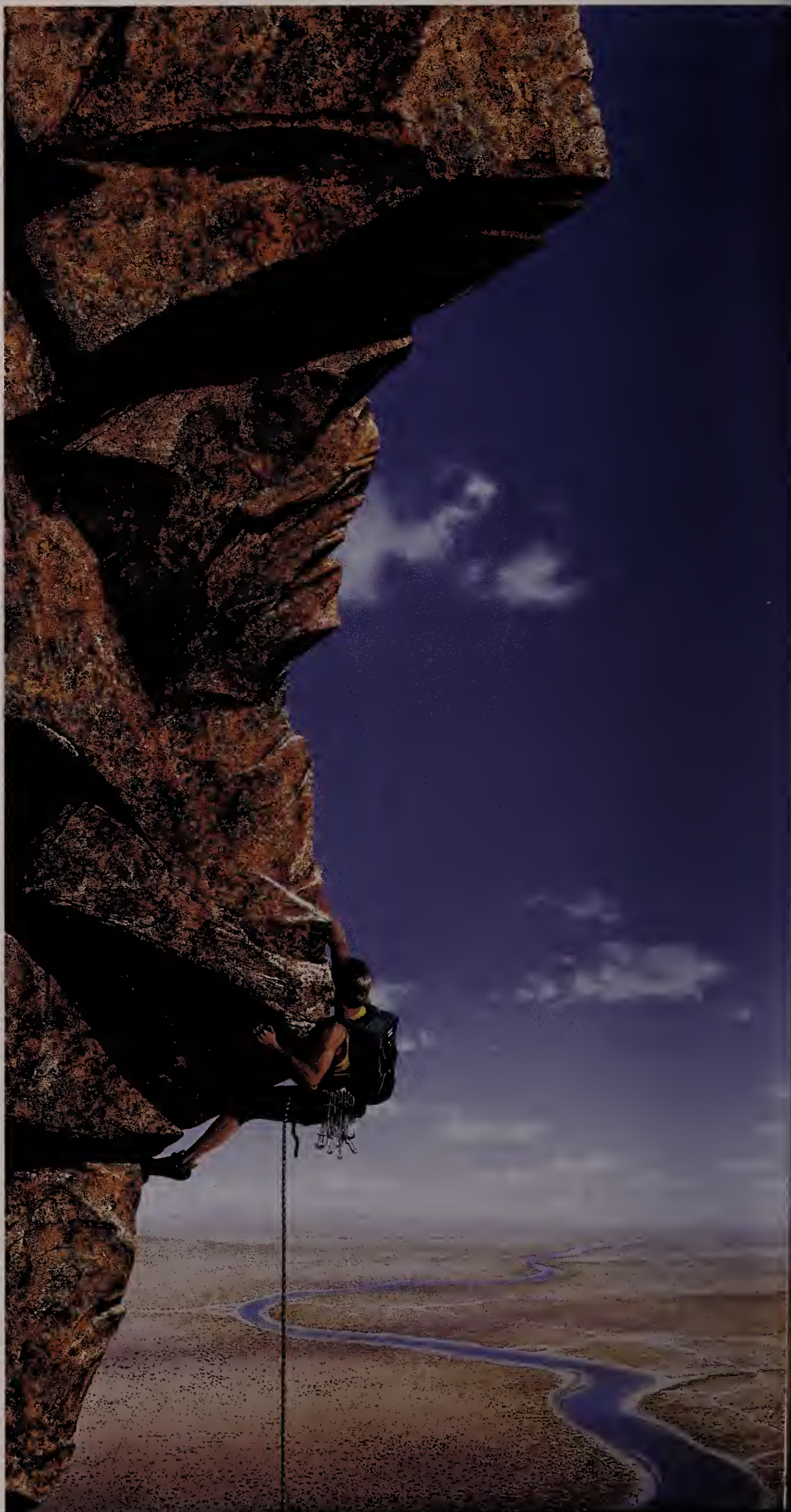
"In 2010, I will be a math teacher. There will be an electronic computer built in on every desk that is like a textbook, and you can see the teacher on the screen talking to you, and you would ask questions by pushing a button on the keyboard."

—PETER N., AGE 12

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limbs will not
be replaced
by a prosthesis
but by robotic
limbs that fully
mimic the
human limb.”

—DAVID S., AGE 12

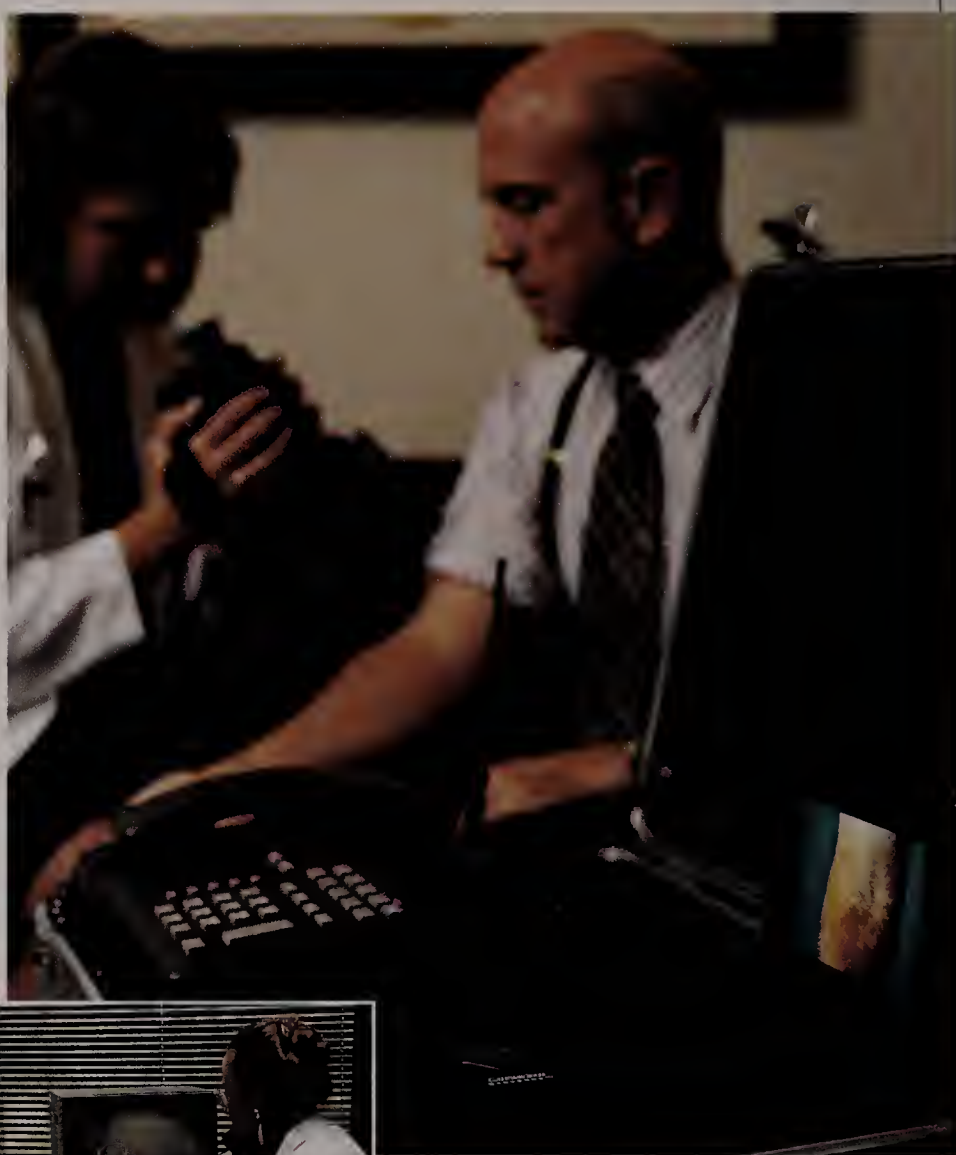
only about 10 percent provide full “distance degrees,” although educators universally predict that the coming decades will even up the percentages.

Beyond the initial technological investment and instructors’ salaries, costs are low, enabling many programs to offer virtual classes for less tuition than that of traditional face-to-face courses. Brevard Community College’s online offerings will jump from the four business and astronomy classes offered in the fall to more than 25 courses in a range of disciplines in January. The school opted to outsource to a commercial service to get user-friendly, state-of-the-art technology. “Our function is creating a learning environment with content and support,” Dubois says. “Building a computer network is not necessarily our business.”

World Community College mirrors other aspects of BCC’s real-world campus, offering a “student lounge,” bulletin boards, study groups, faculty and adviser office hours, a student newspaper and a bookstore. As with telemedicine, skeptics wonder whether the convenience gained in distance education is worth the human interaction lost. And the format does add a layer of difficulty in determining who’s actually doing the course work. However, instructors say they get to know students’ online personalities as well as they would faces and voices in a traditional classroom. And BCC requires instructors of online classes to hold at least one proctored examination in person per term.

THE VIRTUAL HOSPITAL: TELEMEDICINE

MORE THAN 40 YEARS AGO, a few medical pioneers began experimenting with telemedicine—an approach combining telecommunications, videoconferencing and



TELEMEDICINE PROVIDES *greater access to specialty care, yet the investment pays off quickly by reducing unnecessary hospitalizations.*

medical technologies, particularly in radiology and pathology. But in the past few years, more than 50 medical centers nationwide have launched major projects offering direct patient care from a distance in a variety of specialties, according to Dr. Ace Allen, editor of the *Telemedicine Today* newsletter, and he expects the numbers to continue doubling annually for at least the next five years.

Driving the trend are rising health-care costs, plummeting equipment prices (telemedicine setups that 10 or 15 years ago cost \$500,000 can now be had for \$5,000 to \$15,000), and continuing improvements in data compression, image quality, satellite transmission and fiber optics. Telemedicine cuts medical expenses by enabling doctors to confer with distant colleagues, share data or examine patients in a remote location, all without losing time and money to travel. It also allows institutions to operate effectively after downsizing by drawing on specialists elsewhere. “People are looking

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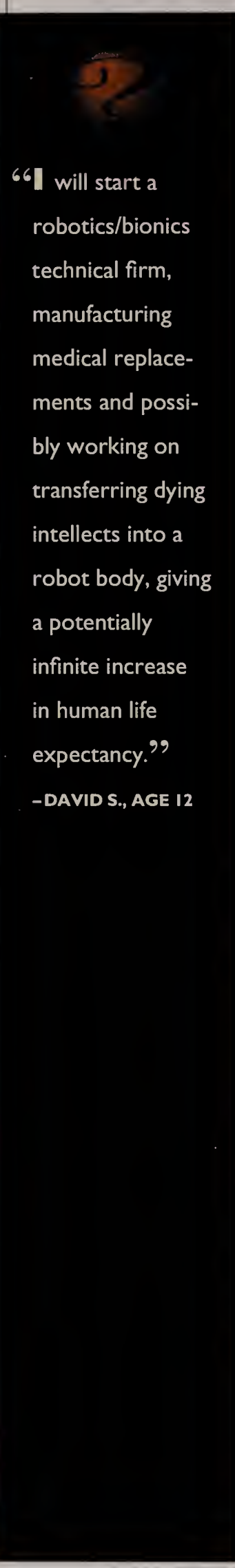
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“I will start a robotics/bionics technical firm, manufacturing medical replacements and possibly working on transferring dying intellects into a robot body, giving a potentially infinite increase in human life expectancy.”

—DAVID S., AGE 12

for ways to do the right thing one time and share the information,” says Steve Rushing, an Atlanta-based Andersen Healthcare Consulting partner specializing in telemedicine.

Health-care organizations have discovered that they can quickly recoup their telemedicine investments because such a system can save thousands of dollars daily by preventing patients from unnecessary hospitalization. At the same time, true believers say, telemedicine provides top-quality care. Take the case of Harris Corp., a manufacturer of electronic imaging equipment. Since February 1995, the Melbourne, Fla., company has been transmitting its employees' X-rays, CAT-scans, mammograms, ultrasounds and other radiological records for analysis by specialists at the UCLA Medical Center located 2,500 miles away. Company executives have predicted that the program will save \$2 million a year over the next seven years in health-care costs while offering employees access to specialty care that isn't available locally.

A study by Arthur D. Little Inc., the Cambridge, Mass.-based research group, indicated telemedicine could slash more than \$132 million annually from U.S. health costs. For that reason, Dr. Jay Sanders, director of telemedicine at the Medical College of Georgia in Augusta, who was among the first to experiment with distance medicine, has predicted that, by about 2010, medical videoconferencing equipment will be as common in doctors' offices as fax machines are today.

Most telemedicine programs involve urban hospitals providing specialty care to geographically isolated areas, including rural communities, Indian reservations and even developing nations. Some small-town hospitals turn to the big-city specialists for advice or second opinions on traumas such as severe burns or unusual eye injuries. And some use the technology to allow distant specialists to examine patients who are too old, too young, too injured or too ill to travel.

Hospitals in at least two states use the technology to examine prison inmates. In a number of states, some criminal-justice proceedings, including arraignments and parole hearings, are held remotely through telecomputing hookups. This saves prison officials the cost and security hassle of transporting inmates to each and every scheduled court appearance, at many of which, officials con-

tend, little or nothing of substance occurs. But remote court appearances are controversial because lawyers and civil libertarians believe that teleconferencing fails to convey all of the possibly meaningful context and nuance that might be important or useful to parties in a criminal case.

But analysts say that telemedicine's true potential lies in home care. In some pilot

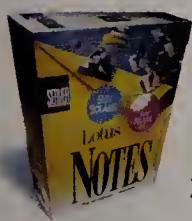
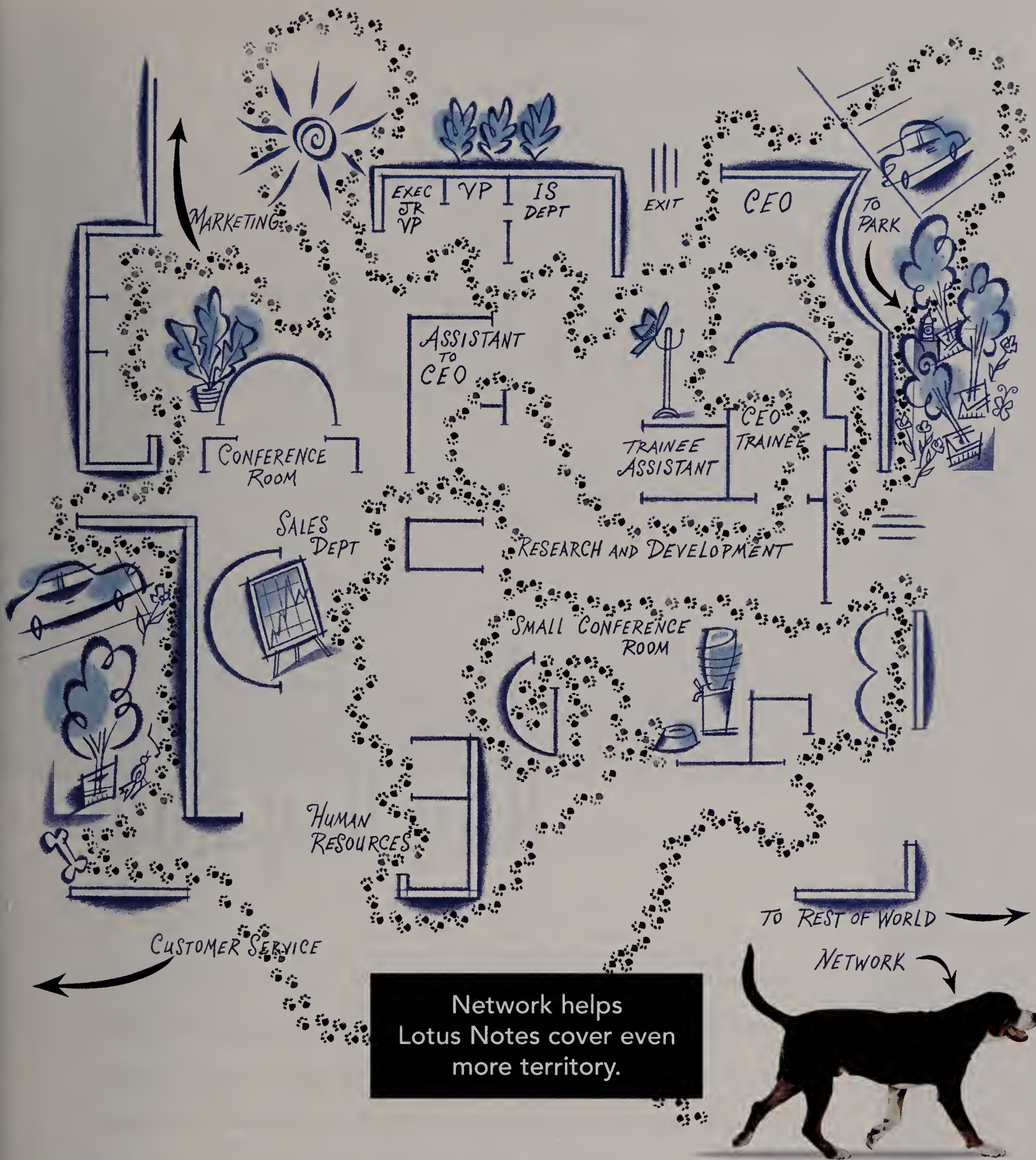
VISIT THE CIO World Wide Web site at <http://www.cio.com> for a list of resources on telemedicine, distance education and telework.

programs, patients can already monitor blood pressure, temperature and other vital signs at home, or consult with doctors or nurses by videoconference, eliminating the need for home health care and possibly nursing home admissions and some office visits. One device, the HANC (Home Assisted Nursing Care) Network, uses voice, video and data transmission to send regular vital-sign readings to a 24-hour health center. HANC, which HealthTech Services Corp. of Northbrook, Ill., hopes to market in mid-1996, even dispenses drugs, checks for potential interactions and verbally reminds patients when they're due to take their pills. That's critical, Rushing says, because patients who don't comply with prescribed drug regimens are most likely to end up receiving an expensive readmission to the hospital.

Telemedicine also has its detractors. Critics say it can interfere with the physician-patient relationship, eliminating the healer's touch. "A lot of psychologists and psychiatrists will tell you that you've got to be in the room with the person; there are things the camera just won't pick up," says Goodenow. Dr. Jerome Kassirer, editor of *The New England Journal of Medicine*, has raised questions about privacy and quality of care.

And what about legal and professional issues? How much should doctors charge for telemedical advice? How will insurance reimbursement work? Can doctors legally practice across state lines? And who's liable if something goes wrong? "There are no standards for telemedicine," Goodenow says. "Right now, it's in a very experimental stage." 

Anne Stuart can be reached via e-mail at astuart@cio.com.



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—MELYSSA G., AGE 13

TECHNOLOGISTS' PANEL

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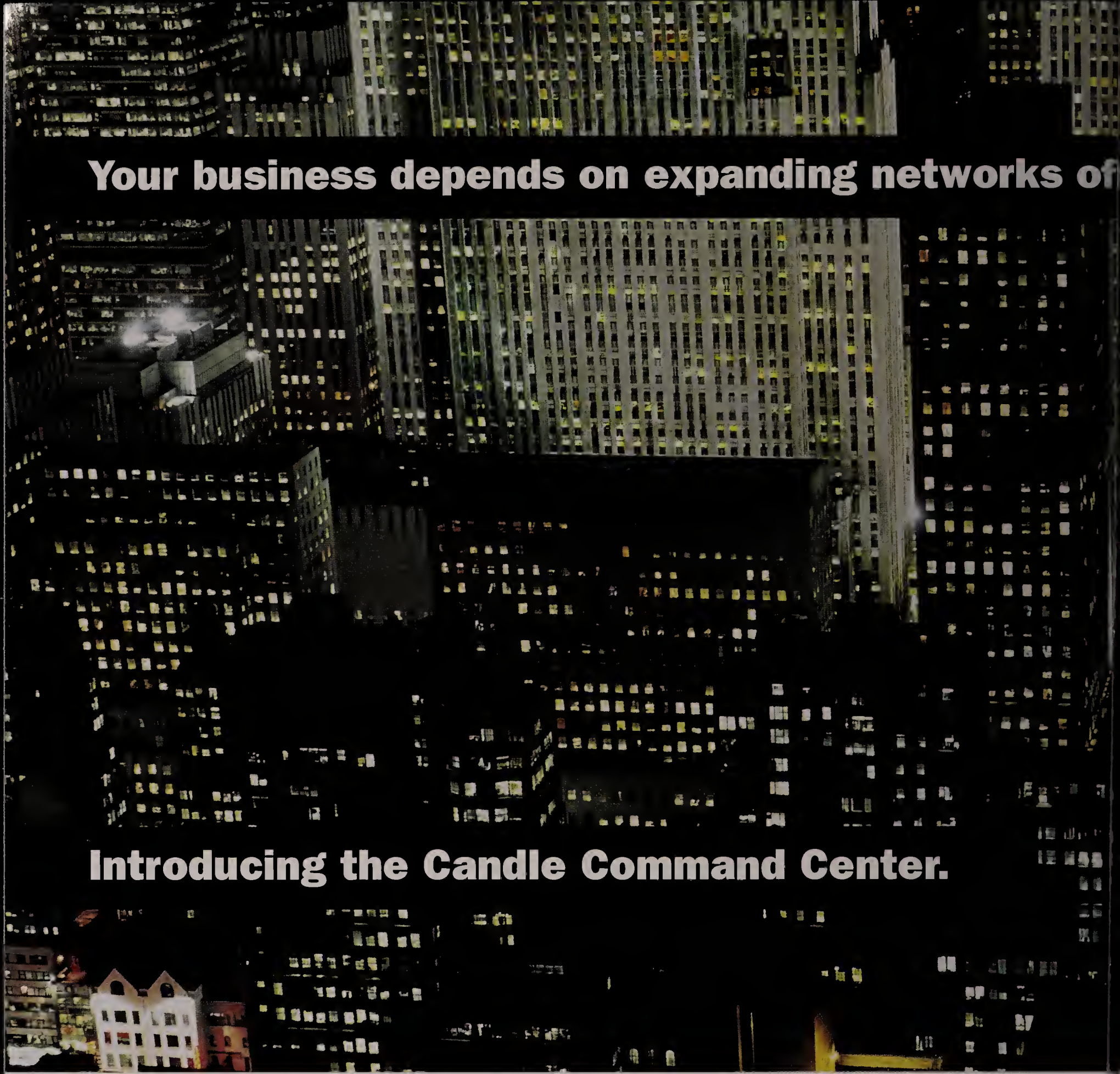
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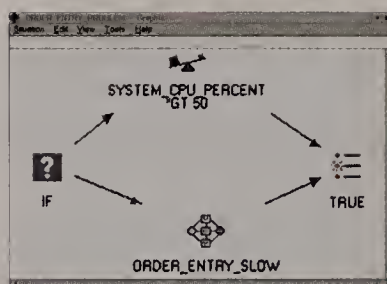
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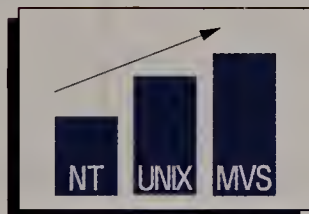
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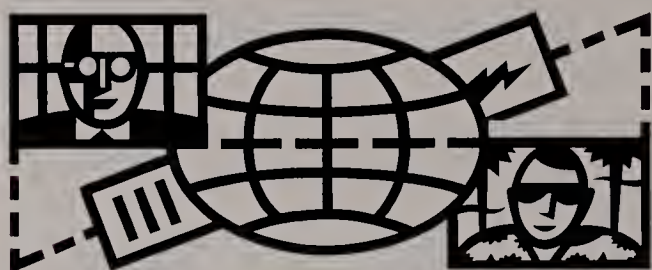
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“In 2010, I’d probably have a museum about the 20th century. It would attract a very large crowd. The children that weren’t born until after the big technology fiasco would wonder how people had fun without virtual reality. How they got things done without personal servants. Pretty pathetic, huh?”

—JADE B., AGE 12

One Number for Voice, E-Mail and Fax

IMAGINE THIS: You are a CEO and your two fiercest competitors announce a merger. The early buzz from Wall Street is not good. As analysts predict that the new company will outmuscle you for market share and new customers, skittish investors unload your stock as quickly as they can.



You have a new service you believe will revolutionize the industry, and you decide to announce it a week early to counteract the storm on Wall Street. But you need to contact your product development chief, who is sailing somewhere in the South Pacific, and your PR and marketing managers, at a trade show in Las Vegas.

No problem. You send the product manager an electronic version of the merger newspaper story. Although he doesn’t have a fax machine aboard his yacht, his personal-assistant telecommunications system automatically converts the text to a voice message that he hears through a miniature earplug device—his only link to the real world. You forward e-mail, also converted to speech by the recipient’s communications system, from the board of directors to your management team.

Twenty minutes later, you initiate a real-time four-way conversation on a secure channel through your company’s private telecommunications network. The product manager on his boat in Papeete harbor, the PR and marketing managers on the exhibit hall floor of the Las Vegas Hilton and you in a jet over the Atlantic plot the company’s next move as if you were all speaking together in the same room.

Within a decade, this technology should enter the mainstream. Customers will have a single phone number for voice, fax and e-mail that they can use their whole lives for both personal and work purposes. This will change the way people use telecommunications devices. You won’t even know your work, cellular and home phone numbers,

which will simply be device addresses, not people addresses.

David Turock is chief technical officer at Telecommunications Premium Services Inc. in Iselin, N.J. His personal-assistant number is 908 632-3804.

A Menu of Two-Way Wireless Options

AS WITH ALL WIRELESS technology, there’s a lot of high expectation around paging, but there’s still room for further innovation. With the advent of narrow-band personal communications services, I think that we’ll see paging begin to grow in two directions, both as a service and as a more sophisticated transactional device. Wireless companies have the infrastructure of network and communications servers in place. They will next start integrating and upgrading the services that they offer.

Two-way paging is the foundation of this trend. Companies are beginning to offer a service in which you can use your pager to answer a query rather than just receive a message. So I can send a message to my travel agent asking her to book me on a certain flight, and she can book it and send me a confirmation via the pager. Companies will eventually build more sophisticated service offerings onto two-way paging capabilities. For example, you might use it for wireless e-mail management, selecting which messages you want to download to your mobile device and which you want the server to send an automated reply to.



To take advantage of new services, the actual paging device will change from a standalone product to a more integrated piece of hardware. For example, a salesman might connect pager to laptop through a serial port to check the inventory database back at corporate headquarters. And as more and more functionality makes its way onto microprocessors, pagers could become a chip set on the motherboard of a laptop or

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“It would be great if you could put on a thinking cap hooked up to a computer and whatever you think prints onto the screen. Imagine you could be sleeping and your dream is written down. That would be great!”

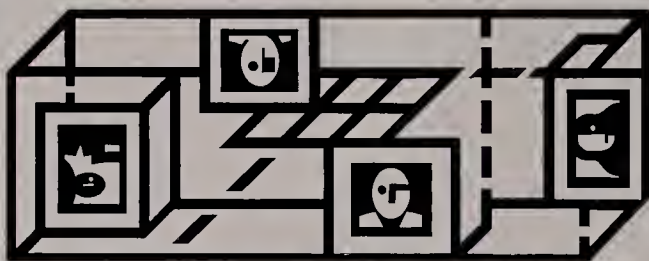
—MAX W., AGE 12

personal digital assistant. You can use the better display and bigger keyboard to transact more complicated services. It's better than four buttons on a pager. Or it will be.

Scott Petry is director of Advanced Messaging Products at SkyTel Corp. in Washington. His e-mail is Spetry@mtel.com; SkyTel's home page is at <http://www.skytel.com>.

Networks That Can Expand in Three Dimensions

IF YOU THINK CHANGES in communications technology have you in a state of flux now, just watch things churn in the next two decades.



The future will be built on what my colleague Jim Gray and I call SNAP, or “scalable networks and platforms.” Systems in the next millennium will be scalable in time over many decades, in space over many continents and in size across different applications. This will allow users to enjoy one system in a worldwide network of computers.

The Internet provides some idea of what SNAP means for computing. We will see everything-to-everything connectivity on a global basis, unlike the more hierarchical client/server model. The Internet could galvanize SNAP, but adequate bandwidth and robust reliability will be needed to make scalability a reality.

Nonetheless, scalable computing is coming. Witness the fact that de facto, so-called “industry,” standards are driving down the cost of platforms to commodity-like prices. Intel's aggressive chip development and standardization around Microsoft Windows have made this possible. Equally important, advanced asynchronous transfer mode (ATM) networks are providing low latency and guaranteed high bandwidth, which is critical for making a scalable system.

As CIOs know, increased reliance on standard platforms, standard operating systems and ATM is happening now. But we

still need ubiquitous high-speed, dial-up bandwidth. It could take as few as two to three years for these networks to emerge, but it will probably take a decade. (Recall that the telcos and cable guys were really wrong about interactive TV, which, it turns out, is going to take longer and cost more than they thought.)

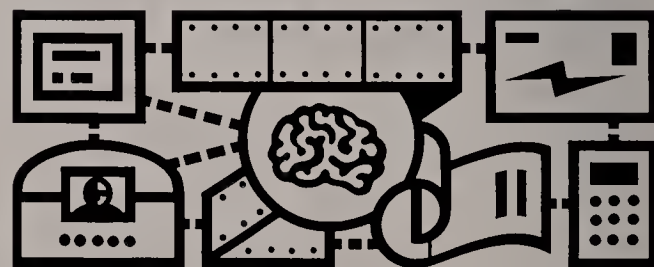
The communications revolution has really just begun. We'll see wireless computing to provide anywhere, anytime connections. LANs and WANs will converge. Video will be delivered via some combination of telephony and cable networks, and the Internet will adopt video, too. Finally, speech input is likely to cause a revolution all by itself.

My advice to CIOs as the computer industry approaches the millennium? Get ready to cope with it.

Gordon Bell, responsible for Digital Equipment Corp.'s VAX minicomputer, recently signed on as a senior researcher for Microsoft Corp. He is working with computer scientist Jim Gray on the Cyberbricks project, which is aimed at “scaling” Windows NT. He can be reached by e-mail: gbell@mojave.stanford.edu.

Intelligent Devices That Talk to You and to Each Other

TEN YEARS FROM NOW, most devices—from printers to PCs to picture phones—will be intelligent, and they will be connected through open-architecture, OS-independent networks. These devices will be able to communicate and interact with one another without requiring a lot of systems integration. The goal is to build a smart network that simplifies the flow and control of information through an organization.



The network environment will be made up of five components. The first is the physical network (the wiring, connections and hubs), which could be fiber, coax, wireless,

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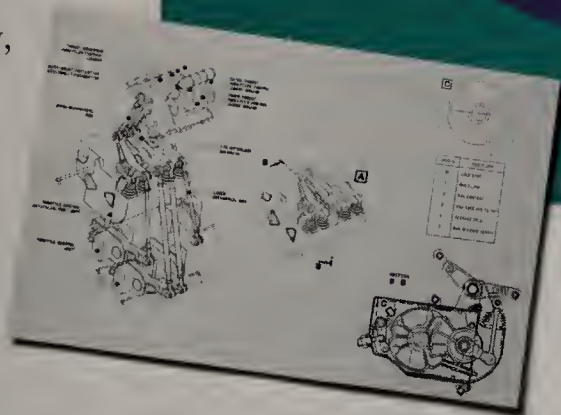
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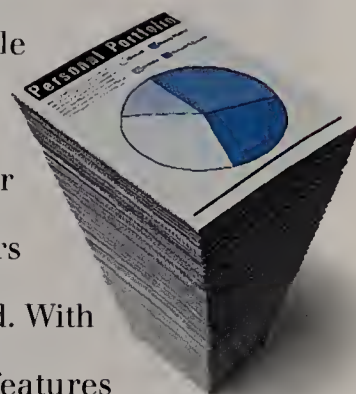
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THE SAME PEOPLE WITH THE HIGHEST FUNCTIONALITY CUT-SHEET PRINTERS FOR AFP.

“I will be living on Mars occasionally, traveling between it and Earth. There will be space travel and a system of instant communication with other planets and galaxies. I would have a little, subtle device in my pocket that would enable me to communicate with the people I work with. The device would also hook me and my work partners' computers together.”

—ANNA S., AGE 12

infrared or even the power lines—whether singly or in combination.

The second is the network agent that resides within a desktop computer or an intelligent device—anything from an appliance to a digital copier. This is what gives a user or appliance access to the network environment.

The network broker brings parties together to find information or a particular device. For instance, say you want to know what's happening in a certain part of the factory. Your agent goes to the broker, which in turn connects you with agents that are on that portion of the factory floor. The broker saves you from having to understand the underlying complexity of the network. The underlying technology that enables the broker is the network directory service.

The next major component combines both internetwork connections and network services. This is the bread-and-butter of getting the information around, whether you're looking for the time, stock quotes, SQL database information from corporate resources, whatever.

Finally, you have a bunch of network-savvy applications that talk with agents and the brokers and are aware of the internetwork services. These give what we call the information lens—the view of all that information and all those control devices on the network. And that's what allows you to build a smart global network.

The opportunity and the challenge for information officers will be to identify the information flows and the control mechanisms within their organizations. Those infrastructure components and the information lens applications will enable them to bring the whole organization together in terms of their knowledge and control.

Darl McBride (DMcBride@novell.com) is vice president and general manager of Novell Corp.'s Extended Networks Division in Provo, Utah. The Novell Embedded Systems Technology (NEST) home page is at <http://nest.novell.com>.

An Explosion on the Web

WITHIN THE NEXT TWO YEARS, there will be 10 million Web sites out there. Companies are using the Web for both internal and external services, and both

segments of the Web will continue to grow rapidly. By the turn of the century, most of the workgroup market that's now primarily dominated by Lotus Notes will be overtaken by Web-based services. That is not to say that Notes will disappear overnight, but it will occupy only a small niche market. The Web will also affect public online services such as America Online, CompuServe and Lexis-Nexis; all will be Web-based in a few years.

The days of writing a Web page using raw HTML are numbered. The market for authoring tools that allow people to create, manage and update sophisticated Web-based services will turn out to be a very large one.



Internet security is essentially an infrastructure problem. It happens to be getting a lot of attention these days, but these issues will be resolved within the next five years. Before too long, conducting secure transactions on the public Internet—including financial ones—will be a matter of routine.

The role of the Web in research and education will also increase significantly, just as it will in business. There may be a very large market for personal information services. Individuals will use their PCs to essentially operate their own Web servers. They will maintain their own personal libraries, telephone directories or rolodexes on the Web.

We hope the industry will continue to evolve in a layered fashion with the same widely accepted standards and vendor independence that has characterized the Web up to this point. The nature of the Web marketplace demands interoperability and remote, cross-network capability for products and services from any vendor. While Microsoft will be a significant and successful player, we don't think that it will own the industry.

Charles Ferguson is cofounder and chairman of Vermeer Technologies Inc. in Cambridge, Mass. You'll find Vermeer on the World Wide Web at <http://www.vermeer.com>.

A SPECIAL REPORT SUPPLEMENT

INFORMATION TECHNOLOGY AND THE BOTTOM LINE

THE FW/CIO QUARTERLY

Unwanted Legacy

Yesterday's state-of-the-art computer system is today's dinosaur.

by Srikumar S. Rao

Remember that expensive new PC you bought for your home six years ago? It had a powerful 386 chip, a full eight megs of RAM and an 80-meg hard drive. It did everything you ever thought you'd need to do.

But now the kids are clamoring for faster, fancier computer games, and your own needs have expanded. The new office suite you purchased needs nearly 100 megs of hard-disk space.

You know you need an upgrade, but you aren't sure what the consequences will be. Will you be able to transfer all your data without having to reenter the names and addresses of all your contacts, the spreadsheets you have created for your clients and the report formats you keep using? Will your old and expensive applications programs run on the new hardware? Will you have to spend even more money buying new peripherals such as printers, modems, external drives and graphics cards?

Multiply your problems by a thousand and transfer them to a corporate situation and you will begin to understand how severe is the problem of legacy computers. Most companies have systems and applications that were once the state of the art but are now hopelessly obsolete. The trouble is that the business still depends on these dinosaurs. The typical corporation has a legacy system consisting of any number of mainframe computers configured to do a relatively few repetitive and large-

scale tasks very efficiently—payroll, order entry, invoices and the like.

But since the advent of PCs, and later workstations, in the Eighties, and then the linking of a company's desktops into local and now wide area networks, PCs are becoming more important as communications vehicles than as individual productivity enhancers. Data on desktops needed to be shared, so small numbers of PCs were hooked together in local area networks. Different LANs sprang up in the same company—in production, accounting, sales, planning and so on. Each group acquired its own hardware to wire the computers together and used the operating system and programs it deemed best for its own needs.

Then, as managers became more comfortable with the new technology, they started to ask more penetrating questions. Desktop and LAN data no longer sufficed. They also needed to incorporate enterprisewide data that resided on company mainframes.

So chief information officers are beginning to grapple with many thorny issues in dealing with legacy systems.

It is no easy task to physically link together and manage disparate LANs. "When you are trying to link computers or systems together, problems crop up at several different levels," says Christian Byrnes, program director at consulting and advisory firm META Group. "It is easy to set up networks poorly. The key to success is to understand a wide variety of requirements

and explore a wide variety of potential solutions and technologies."

Equally complicated is developing applications that can work together. Most often this involves extracting data from one data base, such as Oracle, and manipulating and merging it with data from another data base, such as Sybase. Many data base vendors provide "middleware," programs that can accomplish this task to a limited extent, but much chaos reigns in this field.

Another problem is communicating among different parts of extended networks. The ability to transmit data to all parts of a network is becoming crucial. The principal reason Lotus Notes is so successful is because of its outstanding ability to replicate data.

The pace of change in computer technology—both hardware and software—is accelerating. But suppliers have become more sensitive to the dislocation caused by such rapid change. Hardware vendors are designing easy upgrades into their product architecture. Software suppliers are providing features for easy data portability into later versions of applications.

In the following special report on managing legacy systems, we present two case studies of companies dealing with the need to refine their computer systems more or less perpetually, and a third possibility—outsourcing. ■

Srikumar S. Rao is chairman of the Marketing Department at the C.W. Post campus of Long Island University.



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Network Asset Value

The fine art of continually upgrading aging computer systems at Fidelity.

by Srikumar S. Rao

It's a little like trying to take out an appendix while the patient is playing tennis." That's Albert Aiello's analogy for how a large corporation continually upgrades aging computer systems. Aiello is president of Fidelity Systems, the technology division of Fidelity Investments, the nation's largest mutual fund company. His challenge: "The older systems have to continue to run the business while we fit in the new technology."

As Fidelity's technology czar, Aiello presides over an empire of 1,500 systems people with an annual budget of \$350 million. He understands how technology is reshaping his business. He ought to. He has a Ph.D. in marketing from New York University in addition to master's degrees in both industrial engineering and operations research.

"System objectives must flow from business objectives," he emphasizes. "Business objectives at Fidelity deal with introduction of new products and services, improving customer service and asset growth. System objectives have to do with using resources effectively and introducing new technologies to support business directives."

Sometime next year, when a customer calls to inquire about his holdings in a Fidelity mutual fund, the Fidelity representative will be able to ask him if he wants information on a new aggressive growth fund. "Your daughter will be entering college in five years," the rep might say. "You could consider

it for a portion of her education fund." If John Doe is 60 or so, the rep might suggest a conservative government securities fund as a repository for his IRA rollover.

There is nothing new about such tactics. There is even a term for it, "life-event marketing," which recognizes that there are stages in a person's life when he becomes a good prospect for certain types of products and services. Many

industries and companies tailor their marketing to such knowledge. Fidelity just does more of it than most others and does it faster and better. And soon it will do it in real time over the telephone as well as by mail.

As more and more such technologies are brought on line, integrating them with older systems becomes increasingly complex. In 1990, when Aiello joined Fidelity, if Mary Jones called to determine the status of her Magellan account and the value of the IBM shares in her brokerage account, the representative would have had to ask her for each account number and look up the information separately. He would have had to walk to a quote ma-



Fidelity Systems' Aiello

"The older systems have to continue to run the business while we fit in the new technology."

chine to get current stock prices and a news terminal to find out if anything was happening that might affect them. Mary Jones needed a lot of patience if she had five different mutual fund holdings and a portfolio of a dozen individual stocks.

Today, when the rep takes that call from Mary Jones, his screen automatically fills up with a listing of all her holdings. He can get current stock quotes and news stories. Investment tools permit

him to make interest rate assumptions and answer questions like, "How much money should I put aside each month if I want to have \$50,000 five years from now when my son enters college?"

Service items, such as a request for additional checks, are entered on the terminal, transmitted to a fulfillment center and executed the same day.

Fidelity's computer bank is huge. There are four mainframes totaling about 1,500 mips (million instructions per second, a measure of processing power), four terrabytes of disk storage, a half dozen or so midrange IBM AS400 and DEC computers, 400 Sun workstations and around 12,000 desktop PCs. The high level of customer service al-

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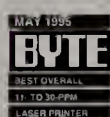
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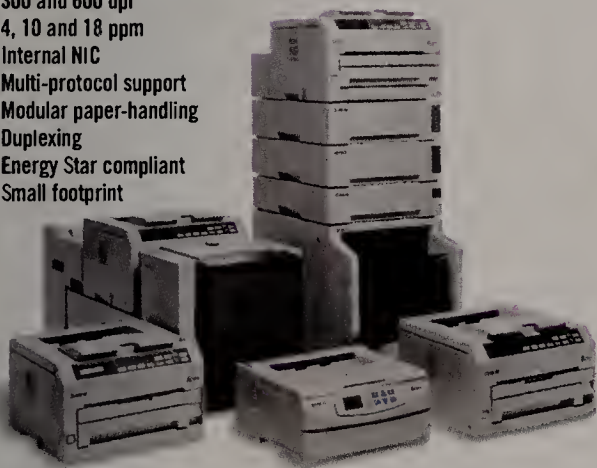


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lowed by this large and sophisticated computer infrastructure, combined with sharply focused new products and highly targeted marketing, have helped to almost quadruple Fidelity's assets in the last six years, to \$520 billion, and the company is still growing at a crackling pace. New mutual fund purchases and market appreciation are likely to increase the value of its assets by more than 25% this year.

Making the transformation was not easy. "We went from a mainframe processing environment to a client-server architecture, and there were not always tools available to do what we wanted," says Aiello. A good deal of ingenuity was needed to handle the many problems that arose. For example:

- Much of the information processing was shifted from mainframes to servers running on Unix. Reports needed to be generated after the transferred processing was complete. Trouble was, Unix did not support high-speed printers, so backlogs quickly developed. "We built an application that takes print from Unix, Windows NT and mainframes and prints it on high-speed printers," says Aiello. "Our Open Print Server takes input from any platform and forwards it to any printer." It was a useful solution that Fidelity plans to sell to other companies.

- Security was a major problem as the number of entry points increased dramatically in the new distributed computing architecture. Fidelity built

its own security routines to encompass all platforms and provide the same—or better—security on Unix and Windows NT than it had on mainframes. It is also convenient. Users do not need to perform multiple log-ons as they switch from one environment to another.

- Mainframes were connected to IBM 3270 "dumb" terminals. They could also be hooked up to PCs. Unix servers, however, needed to be linked to PCs. They could not be connected to the 3270s. "If your environment had hundreds of dumb terminals, it cost real money to switch to PCs," says Aiello. So his team developed an application, called Session Manager, which permitted 3270s to log on to Unix servers. Fidelity was able to phase out the older

A Techie's Dream

How one company shares operational data in real time without crashing its main computers.

Greg Belt, management information systems manager for Crystal Semiconductor, had a problem. PCs had proliferated in the company, raising individual productivity—but the users wanted more information. They wanted real-time access to operational data. They wanted to analyze bookings, billings backlogs and the like, using up-to-the-minute data. Salespeople wanted to know about customer shipments the instant they occurred.

Yet most users did not have the programming skills needed to formulate their queries or arrange the extracted information into the tables they wanted.

"They had a legitimate need for the data they requested," recalls Belt. "But I did not have the manpower to

respond to them immediately. I was very nervous about letting them directly access our operations computers. These computers run our business and if they crash, the company grinds to a halt."

Even if users were experienced enough not to cause the machines to crash, Belt did not see how he could let them link up with the computers that ran the business. "If accounting was analyzing the aging of receivables or making other similarly large queries, it could completely lock the computers," he says.

Crystal, a subsidiary of Cirrus Logic, produces analog and digital integrated circuits used by PC manufacturers. It had five Sun workstations serving different areas such as sales and manufacturing. These were linked,

along with some 400 PCs, in a local area network managed with Novell Netware. Data on the servers was stored in Ingres, a data base product distributed by Computer Associates. Belt set up two additional off-line data bases on Sun workstations. One contained engineering data such as yields on manufacturing runs and numbers of finished products. The other contained marketing, sales and accounting data such as bookings, backlog, shipments, billings and the like. Some items, such as inventory levels, were on both data bases, which were updated one to four times a day.

He also purchased applications that gave nontechnical users a "point and click" method of interacting with the data bases and drawing out the information and reports they wanted.

The solution worked—for a while. Then, as the company grew, six-hour-old data was not good enough. Engineers with quotas to meet at the end of each quarter

wanted to know in real time where they stood. Salespeople getting queries from customers about orders had to know immediately about their exact shipping status.

Belt learned that a replication feature was in the works from Ingres and, recognizing its implication for his problem, promptly offered to help test and develop it. Replication is a method by which data stored in one computer can be transferred to another and updated regularly.

The powerful feature proved to be the fix he needed. "I can classify data bases as 'source' or 'target,'" explains Belt, "and decide which data goes to the target data base. I can decide how frequently the target data base is updated—once a day or as soon as any change occurs. It is a simple menu-driven interface. You don't need programming know-how to run it." Crystal employees finally get the information they need instantly. Belt is happy that his production computers are in no danger. —S.S.R.

terminals at its own pace rather than all at once.

• Training issues arose constantly. Recent employees had a better grasp of new technology but fell short in their understanding of the business. Longtime programmers were not up to speed on technology but understood the processes. Different training programs had to be devised for both in their areas of weakness.

Impressive as Fidelity's present performance is, it is continually raising the ante. An optical imaging system, for example, called XTRAC, is being introduced. Customer documents—such as letters—will be imaged and routed to appropriate employees. At present, if a letter from Mary Jones contains a change of address and a request for her money to be moved from one fund to another, photocopies are made and circulated. Papers have to be shuffled and looked up if she calls and makes reference to her letter.

With XTRAC her letter will automatically be entered in her electronic dossier and routed to the employees concerned. Tickler files will remain open till the issues she raised are dealt with. If she calls, the rep will be able to put the image of her letter on his screen and tell her the status of her requests immediately.

Another technology, digital call logging, will replace the analog taping of phone conversations that Fidelity presently uses. Recordings will be easily retrievable by date and time of call as well as identifiers like customer name and account number.

The redundancies built into Fidelity's systems have stood it in good stead more than once. When a hurricane shut down much of Boston in 1991, callers to rivals such as Scudder got recordings. For Fidelity customers it was business as usual. Calls that would have been handled in Boston were automatically routed to Fidelity centers in Dallas, Cincinnati and Salt Lake City. "The only way you'd know what happened is if you had a good ear and recognized the accents of our operators," chuckles Aiello.

Fidelity's deft use of information technology recently won Aiello the 1995 gold award for innovative use of technology, sponsored by systems integrator American Management Systems and Carnegie Mellon's Graduate School of Industrial Administration.

Aiello has teams constantly evaluating new technologies while others decide which ones should be phased out. Visualization, or the ability to generate three-dimensional representations on a computer screen, is being examined. So is voice-recognition technology. Gone are the days when new technologies were simply cost-effective replacements of old ones. Today they are strategic enterprisewide applications with complex ramifications. "Technology has to be flexible," says Aiello. "Customer demands are constantly changing. Our investments in technology have to evolve to meet these changing needs. Firms that manage this function successfully will pull away from the crowd." Fidelity must be doing something right. It is pulling away in performance from other fund families at an accelerating pace. ■

When in Doubt, Outsource

Hard-pressed chief information officers are using outsourcing to cope with the hassles of managing and upgrading technology.

by Srikumar S. Rao

L

ast year Xerox agreed to shell out \$3.2 billion over 10 years to EDS to manage most of its computer resources at locations all over the world. The deal was part of a massive reengineering effort designed to save nearly \$1 million a day. Xerox expects to slash its information technology costs dramatically.

What's happening here is that changes in information technology have become so dramatic and rapid that many companies, like Xerox, are throwing up their hands and passing the problem to more and better-equipped service providers. *Information Week* reports that outsourcing contracts are becoming more comprehensive and are regularly topping \$1 billion in value.

Outsourcing used to be seen as something resorted to by small, technologically backward firms with financial problems. No longer. Large companies, which considered themselves technologically sophisticated a few years ago, are jumping on the bandwagon. "Mainframe and data center outsourcing has been around for decades," says Hugh Ryan, a managing director for Andersen Consulting. "It is now a mature business. Client-server outsourcing is just starting. The first distributed computing systems installed about five years ago are now becoming legacies. This will be a rapidly growing business."

In a typical arrangement, the service supplier hires the customer's staff and then makes an upfront payment for the computer assets sufficient to cover the first year's operating costs. The target is to reduce the customer's costs in subsequent years by anywhere from 10% to 50%.

Rick Roscitt, managing partner of AT&T Solutions' worldwide outsourcing practice, firmly believes that companies should determine and stick to their core competence, which, in most instances, does not include becoming an expert on technology. "Companies survive and prosper by reacting fast to customer needs and the changing market environment," says Roscitt. "Trying to manage technology in-house could rob the core of scarce resources and cause the company to react more slowly."

Putting in an unabashed plug for his company, Roscitt



AT&T Solutions's Rick Roscitt

points out that AT&T Solutions' own core competence is in networking, an area that most companies are finding too difficult to master. AT&T Solutions has more than 100 clients around the globe for whom it provides a variety of services including network management. Many companies find it cheaper and more convenient to let AT&T handle phone-intensive customer and employee help desks. For example, most Kraft products have an 800 number printed on their packaging. Call the number, and a courteous AT&T employee will answer the phone in Kraft's name. The employee will answer questions, resolve complaints and take whatever follow-up action is required. Kraft gets summary and detailed reports at specified intervals.

"If a company cannot transform from a legacy to a new system or a strategic vision is not being met, it is time to examine fresh options," says Roscitt. "If an insurance company wants to get a policy out in one day rather than three weeks and finds itself stymied, consider outsourcing."

Strapped state agencies are experimenting with innovative methods of financing the switch from antiquated to current information processing methods. The state legislature recently broadened the responsibilities of California's Franchise Tax Board. In addition to collecting corporate and personal taxes it is now charged with collecting child support payments and Department of Motor Vehicle fees.

American Management Systems, a technology and consulting firm in Fairfax, Va., linked together California's legacy systems. Information about a company was typically scattered. Motor Vehicles had details of cars and trucks owned, Employment had W-2 and payroll records, the Board of Equalization had sales tax information and so on. The new system places at the fingertips of the tax collector various pieces of collection information about the corporation, including the most current address and phone numbers, a list of officers and so on.

"Companies survive and prosper by reacting fast to customer needs and the changing market environment."

In addition, the system automates the processing of delinquent tax accounts and ranks, in order of priority, the steps that should be taken with each one. The system became operational in March 1995. The Franchise Tax Board realized an increase in revenues of more than \$25 million in the first five months of operation. AMS hopes to help the FTB achieve the same level of efficiency by 1996 in activities like collecting child-support payments.

"What is remarkable about the FTB project is California's willingness to focus on best value, not lowest cost," says John Podlipnik, vice president of AMS. "We are in true partnership with the FTB. AMS laid out all the money for the upgrades and gets compensated by receiving a percentage of the increased revenues up to the the

value of our bid. If we don't deliver on our promises of increased efficiency, we don't get paid."

Mike Meyer, executive vice president of Cap Gemini America, a division of multibillion-dollar French information technology firm Cap Gemini Sogeti, points out that part of the reason companies are facing problems man-

aging their computer technology is that the businesses themselves are undergoing transformation. "When the basic nature of the business changes, technology also changes," says Meyer. "Managing both types of change is dizzying in its complexity."

Meyer advocates a piecemeal, but coordinated, solution to the difficulty. "Try moving to a new set of open platforms internally," he suggests. "Take legacy applications to an outsourcer and contract out ancillary functions such as training, network support and help desk."

It makes you wonder: With all the outsourcing, what will be left to do? ■

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New Year's Evil

With a virtual time bomb ticking away in mainframes everywhere, many CIOs have some serious issues to deal with before they can party like it's 1999

BY JOHN EDWARDS

Nearly everyone is looking forward to celebrating the new year on Jan. 1, 2000. After all, it won't be just another new year. It won't even be the turn of another century. The birth of a new millennium is just four short years away.

Yet many CIOs are keeping the party hats and champagne on indefinite order. For them, the first day of the new millennium looms as a deadline for disaster.

The reason for the less-than-celebratory mood: two little digits that are causing one enormous problem. It seems most computers are programmed to assume that the "95" in their date fields signifies "1995"; so, at the stroke of midnight as 1999 draws to a close, computers everywhere will read "00" but think "1900." As a result, a 30-year mortgage that's written in December 1995 and scheduled to end in December 2025 will be seen by the computer as starting in December 1995 but somehow ending in December 1925. It would be funny if it weren't so disastrous.

The time bomb set to go off in 2000 is one of the

key problems CIOs and their organizations will face over the next few years, according to the Gartner Group Inc. The market research company, headquartered in Stamford, Conn., says an average midsize company has 8,000 legacy programs supporting business operations. These programs generally have a total of 12 million lines of code. Since one of every 50 lines of code on average has a date reference, approximately 240,000 lines of code would require modification. At an estimated cost of 30 to 40 cents per line of code for programming costs only, a company can expect a \$3.6 million to \$4.8 million expense to fix the problem. That doesn't even take into consideration the costs for documentation, systems integration testing and project management, which, in some instances, could bring the cost closer to \$1 per line of code.

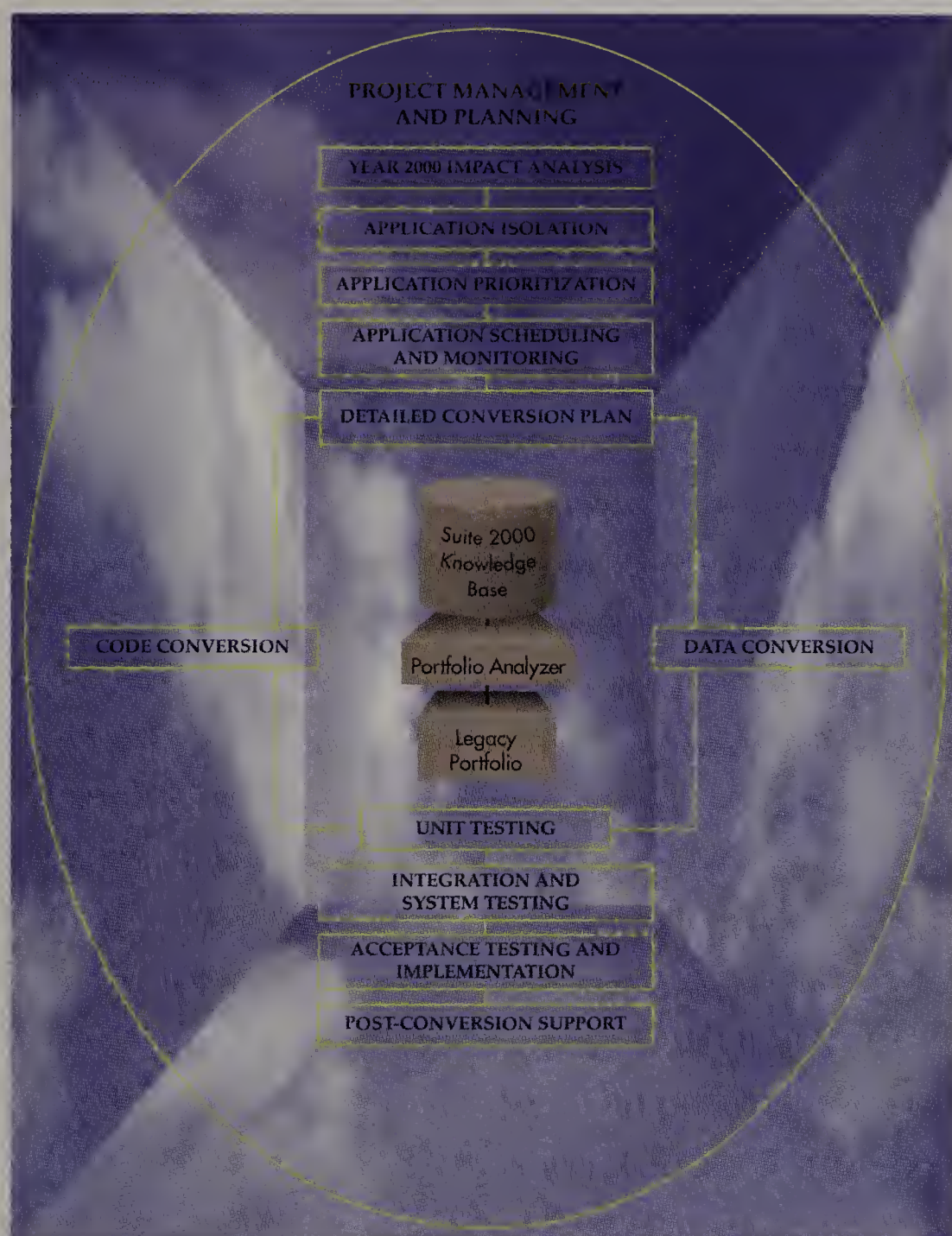
On the whole, remedying the situation is expected to cost the IS world somewhere between \$300 billion and \$600 billion, according to Gartner. For the typical organization, that could result in an estimated charge of 5 percent to 10 percent of its annual IS budget over the course of the next five years. Some enterprises, lucky enough to get a head start on the problem, were able to spread the cost of converting their applications and data over several years. But Gartner notes that the cost of converting systems could ultimately sink a number of already financially unstable companies.

Making the situation even more perilous for many CIOs is that the issue isn't usually covered in contracts organizations have with outsourcers. As a result, CIOs who assumed that a fixed-price facilities contract protected them from something like the pending millennium mess are in for a rude awakening.

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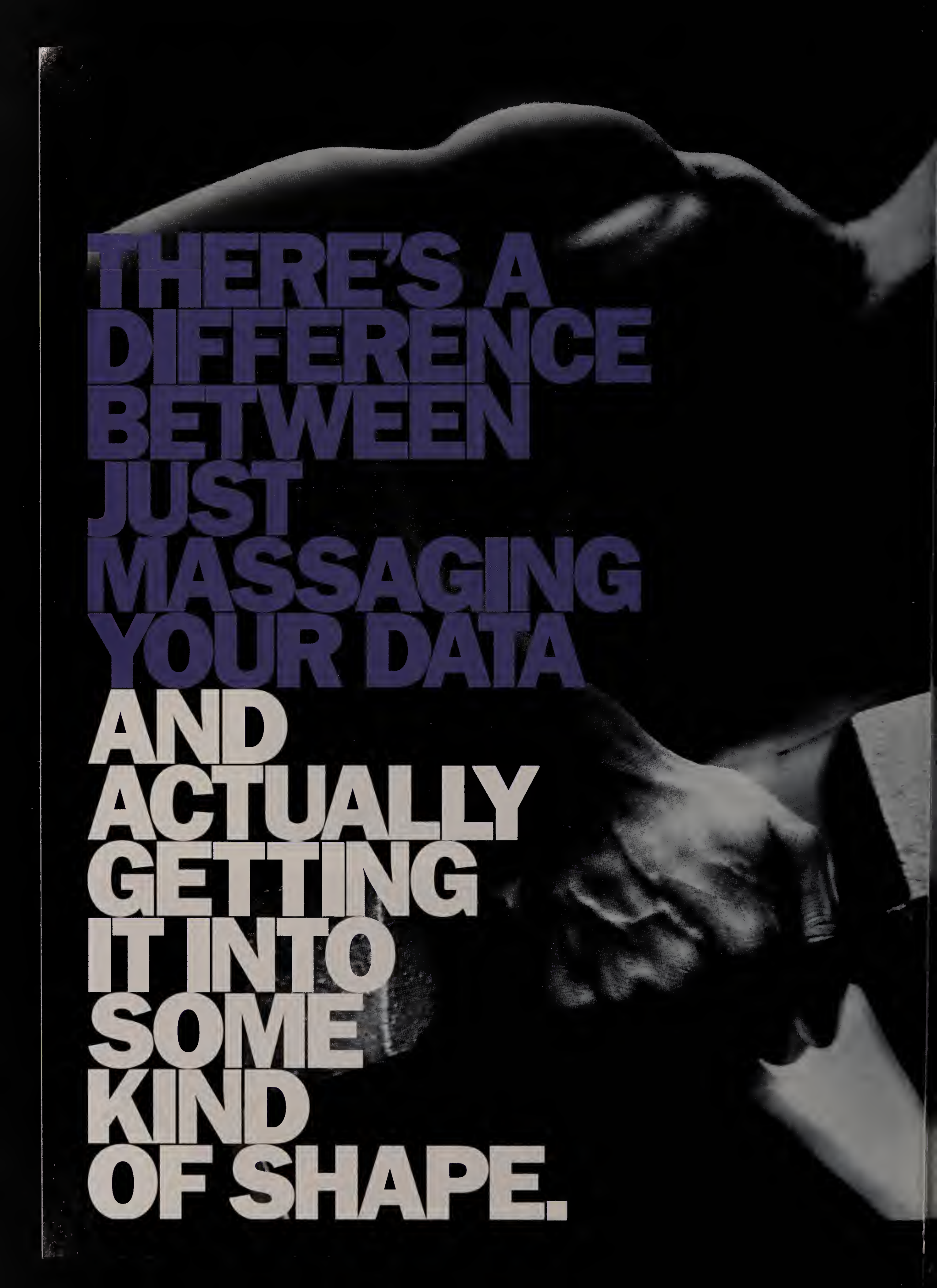
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Back in the mid-1960s, in the mainframe's heyday, few people gave the "2000" problem any thought. For starters, 30-year mortgages were virtually unheard of, and most other financial instruments, even long-term bonds, were due to expire well before 2000. More important, storage space was as precious as gold, and the concept of saving two digits in thousands or even millions of database records sounded like a great idea. So what if it led to trouble down the road. Let your successor deal with it while you sip margaritas on the patio of your retirement home.

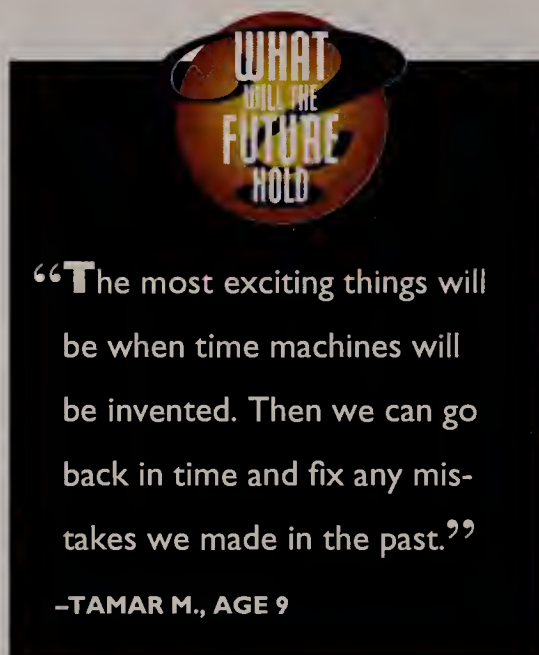
Many of those successors now are steaming mad at their predecessors, which does nothing to solve the problem at hand. As with many situations, the first step in defusing the time bomb is to recognize that a problem exists. "Even at this late date, there are many CIOs who remain blind to the situation," says David Eddy, director of marketing for Global Software Inc., a Duxbury, Mass., company that helps organizations untangle these coding problems. Eddy explains that while many rank-and-file IS staffers and managers are acutely aware of the impending crisis, a number of CIOs tend to downplay the problem's importance.

Eddy notes that many CIOs, fearful of the cost involved in fixing the problem, will wait until the absolute last minute before alerting the rest of top management to the imminent peril. "Many CIOs delay dealing with the problem until there's no escape before coming to grips with the issue," he says. "They're afraid that their heads will roll when their CEOs discover the scope of the problem. Yet, by waiting, the problem only gets worse. It's like the deer frozen by the headlights of a car."

But with more CIOs coming to grips with their predicament, the situation is gradually improving, says David Reingold, vice president of strategic services and marketing for Computer Horizons Corp., the Mountain Lakes, N.J.-based consulting company. "A year ago, we spent a lot of time explaining the problem,

but that no longer seems to be the case," he says. "Particularly in the finance and insurance industries, the reaction now is, 'We know we have a problem. Show us how we can get money budgeted so that by 1997 we can have projects going.'"

While many banks, insurance companies and other organizations were forced to deal with the year 2000 problem back in the 1970s and '80s, orga-



nizations in all fields must now confront the issue, says Global Software's Eddy. From the retailer offering four-year revolving payment plans to the colleges that plan schedules four years into the future to the Registry of Motor Vehicles' cycle of renewing car registrations, the year 2000 time bomb is set to detonate for all.

Besides changing or replacing the application software, what amounts to millions of data records will, in many cases, also have to be fixed to match the updated program. "It's a problem with a very wide scope," says Eddy. "You're not only looking at database records, but system software, operating systems, packaged systems, spreadsheets and so on."

Preventing the time bomb's detonation, or at least containing its damage, is a task that can tax the abilities of even the most well-oiled IS operation. And since most IS organizations finding themselves mired in the predicament probably weren't very well-oiled to begin with, the situation may be doubly tricky to resolve.

The first step toward pinpointing

and resolving the issue is to undertake a thorough inventory of all systems, says Computer Horizons' Reingold. This lengthy and painstaking process involves poking through every application and database in the enterprise, looking for potential trouble sources. "Unfortunately, not every date field out there is shouting, 'I'm a date field,'" quips Reingold. "They're hidden. And some fields that look like date fields aren't. It's a big task just getting a handle on the situation."

Reingold notes that each organization faces a unique situation. Some will be lucky enough to escape with only a few missed payment deadlines while others may face a collapse of their entire accounting systems. Few have recognized and corrected the problem a long time ago and are now facing the future with "millennium-proof systems."

Once the extent of the problem is clear, it pays to be honest about the situation. "You can't keep a problem of this magnitude quiet anyway, so you may as well reach out to get help from others within the organization," Reingold says. It may be in the company's best interests for the CIO to convince senior management that this isn't "a laughable little problem" but could be a serious threat to the organization's long-term viability. Reingold says the CIO needs to discuss the situation with the CEO, CFO, and business and financial executives, as well as with key managers in the IS department.

A savvy CIO can turn the time bomb from a "tremendous problem into a tremendous opportunity," says Iain Lopata, an associate partner at Chicago-based Andersen Consulting. He notes that a CIO can view the situation as a pole vaulter might—simply interested in flying over the obstacle—or as a hurdler who is concerned with leaping over the barrier but who is also interested in finding out what's on the other side to continue his run. According to Lopata, a CIO can take advantage of the impending crisis—one of the largest maintenance efforts any organization will ever face—by making it a part of a long-term IS strat-

egy. "There are many things you can do with the application and data," he notes. "You can re-host it, you can do functional enhancements or you can replatform. You have to look at the opportunities to find out how to turn the crisis from a drain on resources into something more valuable."

Computer Horizons' Reingold agrees. He compares the situation to a surgeon working in an operating room. "While you're tending to 'the patient,' it would be seriously short-sighted just to go in to expand the date field without addressing other afflictions that the proper analysis might bring you," he says. Then, Reingold adds, after a careful analysis, IS might decide to "sunset" a group of systems that aren't up to the task at hand, or it might want to undertake new development work or migrate to another platform. Reingold says IS might also spot the need for improved maintenance or a completely new application. "You never know what you're going to find, but it's a good time to take a look," he says.

But Lopata warns that simply adding new technology won't necessarily allow an organization to sidestep the time-bomb issue. "For example, migrating legacy mainframe software to a client/server network, by itself, isn't a bad idea. But you're talking about a major undertaking. Plus, you run the hazard of simply moving the problem from one environment to another." Lopata notes that an analysis of your system's vulnerability to the time bomb is a good time to study and plan generally, but the focus should always remain on solving the immediate problem.

And organizations would be wise to try to anticipate the unexpected, says Andersen's Lopata. He notes that companies hit by the time bomb can find themselves, for instance, on the receiving end of a serious public relations gaffe. "As the 21st century approaches, we can expect to see more newspaper stories with headlines like, 'Grandma, 104, invited to attend kindergarten,'" says Lopata. "At that point, your business is faced with handling both an IS and a PR mess."

Lopata points out one final pitfall facing CIOs before the issue can be put to rest: the sudden impact of a merger or acquisition. He notes that more than one CIO has felt confident that his organization is completely free from any headaches due to the millennium problem, only to discover that the systems he's about to inherit from a pending acquisition are riddled with problems. "It's vital that year 2000 issues are

FOR MORE INFORMATION:

For some practical advice on the year 2000 date-change issue, check out the aptly titled quarterly newsletter, *Tick, Tick, Tick*, from 2000AD Inc. You can get subscription information by phone at 718 643-8425 or by e-mail at 71776.3131@compuserve.com.

Or visit the Year 2000 Information Center's home page at <http://www.year2000.com/cgi-bin/clock.cgi>. Updated monthly, the site includes several hypertext documents that include a look at the issues and some solutions to the problems.

Finally, the Millennium Solution package, available through Millennium Crisis' Web site, claims that companies can avoid massive reprogramming efforts by instituting simple business and minor application changes. For more information, visit: <http://www.prairienet.org/~dwcollin/millen.html>.

made a part of the assessment of the IT infrastructure that the organization is taking on board," advises Lopata. He notes that it's up to the CIO to make top management aware of any possible year obstacles hidden within the new systems. "We're talking about something that's very critical. This is the sort of thing that, under some circumstances, and considering the potential costs involved, could actually kill the merger or acquisition." **CIO**

John Edwards, a freelance writer based in Mt. Laurel, N.J., can be reached by e-mail at 70007.412@compuserve.com.

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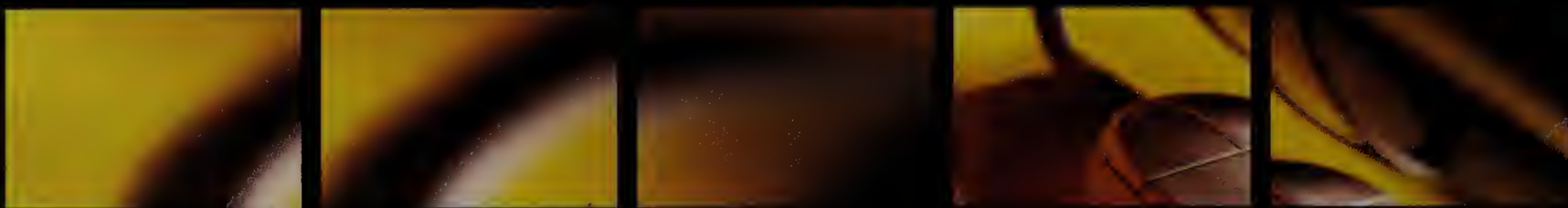
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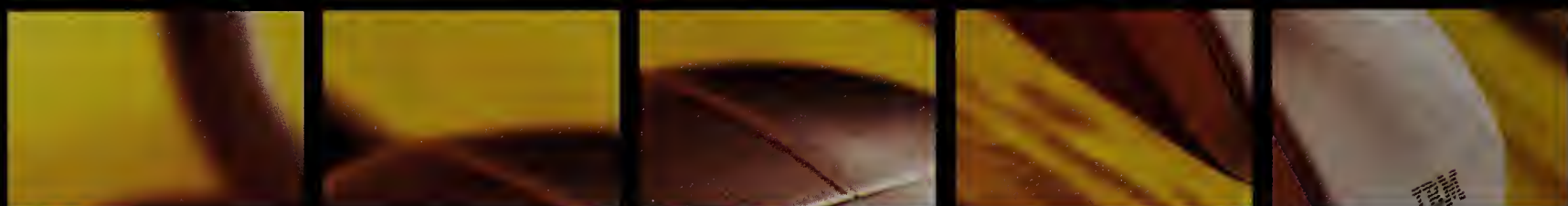
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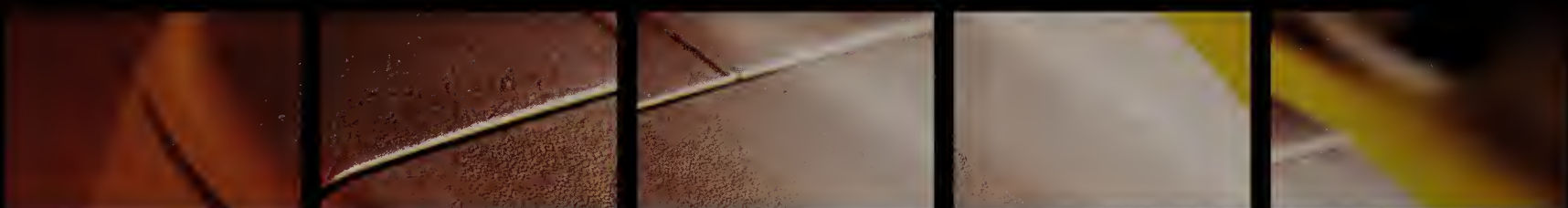
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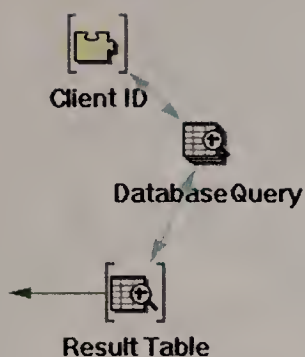


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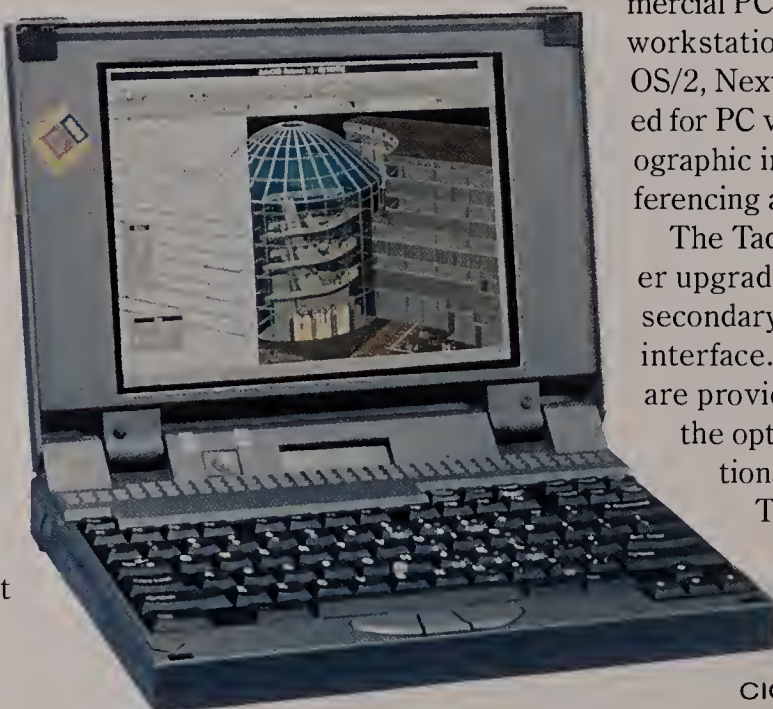
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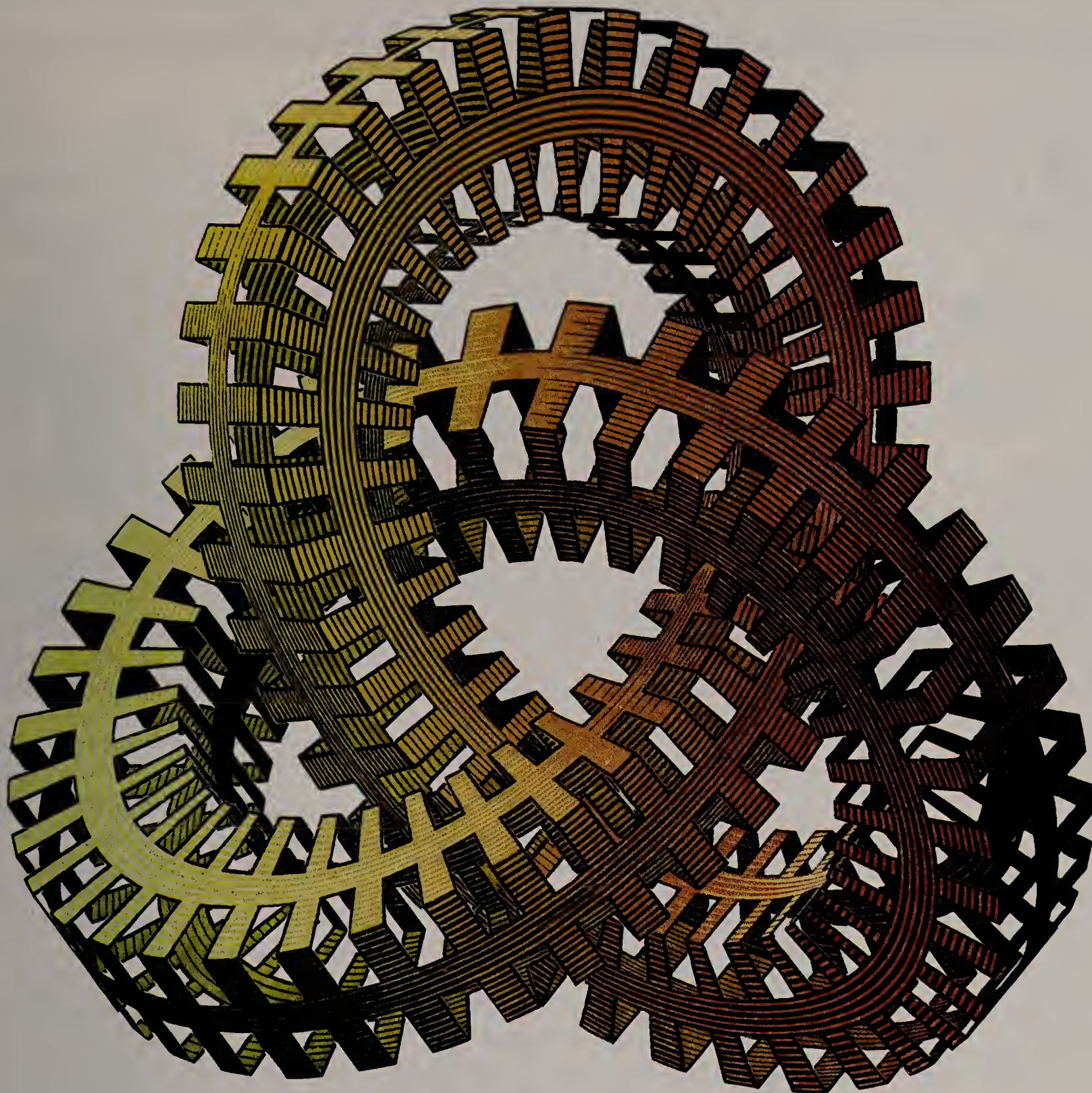
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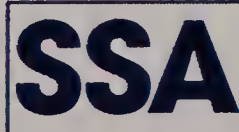
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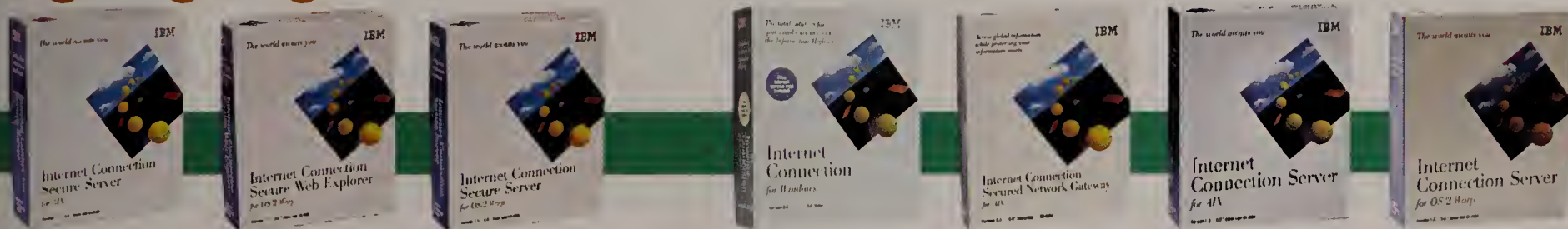
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Continued from Page 96

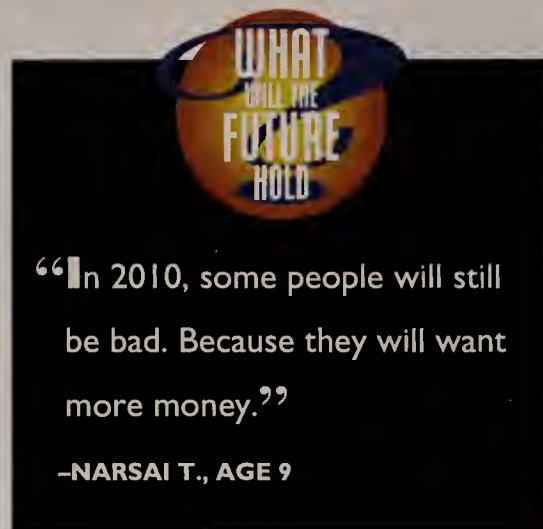
what unique insight, in short, what gimmick? After pondering this matter long and hard, I've come up with two things that set my new consultancy, Ezra Poundcake's Institute for Stuff That Hasn't Happened Yet, apart.

Thing Number One: While other, lesser futurists restrict their predictions to the next 10 or 20 years, I, Ezra Poundcake, will fearlessly forecast the future for the next three centuries—even further if you're willing to pay for it. 1999 or 2999—it's no hair off my back. And, unlike my short-term predictions, any trends or events occurring more than, say, 150 years out, are *guaranteed* to happen, or your money back (unless this cryogenics business is successful, in which case all deals are off).

Thing Number Two: It is common knowledge that a.) the modern history of this country is best reflected in its media and b.) history repeats itself. Therefore, at Ezra Poundcake's Institute for Stuff That Hasn't Happened Yet, we base all our predictions on an exhaustive analysis of past television programs. In doing this, I have chosen to focus on sitcoms, both because I believe they are the truest mirror of the American soul and because the plots are easier to follow. (My webmaster, Jack-O, informed me recently that *Miami Vice*, starring the gruff, yet boyish Don Johnson and the brooding, yet spiritual Phillip Michael Thomas was in fact often about drugs! I suspect that Jack-O is misinformed, or at least I am fairly certain most of the viewing audience never picked *that* up. But you can see why I feel safer talking about *Night Court*.)

How does this system of prognostication work, you inquire? I'll give you a for instance: Based upon the prevalence in the '60s of programs like *I Dream of Jeannie*, *Nanny and the Professor* and *Bewitched*, I predict that sometime in the next 10 to 20 years people will begin taking more supernaturally endowed persons into their homes in the role of domestic help or spouse. (This would, to some degree, alleviate the illegal alien

problem that has dogged so many public figures of late. In fact, the recent awarding of an Emmy to Ray Walston, who portrayed Uncle Martin—arguably television's first illegal alien—suggests that the tide is already starting to turn.)



I also predict that the democratization of Eastern Europe and massive cuts in domestic defense spending will turn out to be relatively unimportant developments. Instead, the most significant result of the end of the Cold War will be that the military becomes a more fun and wacky place in which to serve, as our armed forces reinvent themselves in the image of *F. Troop*; *Gomer Pyle, USMC*; *McHale's Navy* and, of course, the late, great *Operation Petticoat*. Finally, a careful study of such hayseed hits as *Green Acres*, *Hee-Haw* and *Petticoat Junction* leaves me confident that, even as farm subsidies shrink, our agricultural communities will continue to prosper, supported by a cadre of nutty, yet lovable townsfolk who will keep sidesplitting and spirits soaring.

Of course, not every major development can be predicted by watching television. As any futurist worth his salt will tell you, wild guessing plays a critical role as well. Here then are some additional glimpses of events to come, on which you are invited to bet, if not your life, at least your company:

■ The miniaturization trend will reverse itself, and the health-care system will become unbearably strained by people who have injured them-

selves carrying around radios the size of dumpsters.

■ The Food and Drug Administration will declare Plasti-goop a vegetable.

■ A new technology paradigm—lilty logic—will enable companies to create smart machines, all of which will work like clothes dryers.

■ Most major consulting firms will be taken over by cults (this is already starting to happen).

■ Hysteria over the greenhouse effect will subside as people realize that greenhouses are really very nice places where you can see pretty flowers all year long.

■ The girl from *Casper* and *The Addams Family* movies will get her own series.

From just these few examples, it should become abundantly clear what advantages you will accrue by enlisting myself and my staff of *certified** futurists to help you see what's down the road, round the bend, over the horizon and up the next tree for your organization. While your competitors are still fumbling around trying to solve their customers' problems, you can concentrate, instead, on solving the problems of your customers' great-great-great-grandchildren (demographically defined as that oh-so-desirable group of minus-148 to minus-118-year-olds). And please, don't listen to all those so-called visionaries who go around proclaiming that "the future is now" and similar eyewash. Trust me, the future is much, much, much later. We haven't even seen the trailers. **CIO**

*All employees have been certified by the not-technically-for-profit-but-not-ruling-anything-out-either International Committee of Visionaries, Futurists and Really, Really Good Guessers.

Sir (seer in residence) Ezra Poundcake, the former crossword puzzle editor at TV Guide, is president of Ezra Poundcake's Institute for Stuff That Hasn't Happened Yet and the intellectual muscle behind Ezra Poundcake's Home Page for Cybersavvy Business People (<http://www.cio.com/WebMaster/wmezrahome.html>). Ezra's correspondence is handled by his longtime amanuensis and scapegoat, Leigh Buchanan (buchanan@cio.com).

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Future Shtick

This future business is a hell of a racket. Imagine, people pay you money today to tell them what's going to happen tomorrow, and even if you're wrong they can't take it back!

I got this from my old friend Arlo, until recently a sprinkle jockey at Baskin-Robbins and now a consultant to several Fortune 500 companies. Arlo told me his new career started with an epiphany that he had when a customer asked him a presumably rhetorical, yet somehow powerfully provocative question: "How many more damn flavors are they going to come up with?" "If I could tell you that, my friend, I'd be a wealthy man," replied Arlo, nodding (or so he reports) sagely. The next day he was picking his hangnails in the offices of captains of industry.

As a futurist, Arlo has become far more influential and respected than he was even in those heady days at the helm of the shake machine. All he has to do is let fall some dire-sounding nonsense about "the impending techno-apocalypse" or "the information oligarchy in post-humanist society" and legions of C-blank-Os fall worshipfully at his feet. And it's not as though he's had to develop any extraordinary insight or vision: Most of the reports he writes are generated by selecting random passages from volumes of corporate haiku ("Empowered teammate/The wheel has passed to us but/Not to reinvent"; "O freedom giver/Unbind the chains of service/Downsizing is love.")

Considering how little effort Arlo puts into his various pronouncements, the payback has

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BY EZRA POUNDCAKE

been substantial. His first book, *The Future Is Coming, Duck!* and the follow-up volume, *No, Lower!* have both been on *The New York Times* best-seller list almost as long as *The Discipline of Market Leaders* (and Arlo has cooked up an "I'll-buy-2-million-of-yours-if-you'll-buy-2-million-of-mine" deal with Treacy and Wiersema that should ensure a long shelf life for all three). In addition, his inspirational videotape ("Que Sera, Sera—Not!") has been hailed by Bill Gates as "the thinking man's Magic 8-Ball," and he has a standing invitation from Newt Gingrich to bed down on the Speaker's rumpus-room sofa whenever he's in Georgia. Taken together with the bucks he rakes in from public-speaking engagements—and

he's pulling down the same fees as such luminaries as Sargent Shriver—all this attention has made my pal Arlo a wealthy and influential character. Although let it be said that he remembers his humble roots and is never too busy for a collegial game of miniature golf or a tuna melt at Friendly's.

Now as my loyal readers know, Ezra Poundcake has never been one to let a good bandwagon pass by unjumped. If people are hungering for a window into the future, I can be as big a pane as anybody! The question becomes, what can I offer that the Tofflers and the Saffos cannot—what irreplicable wisdom, *Continued on Page 94*





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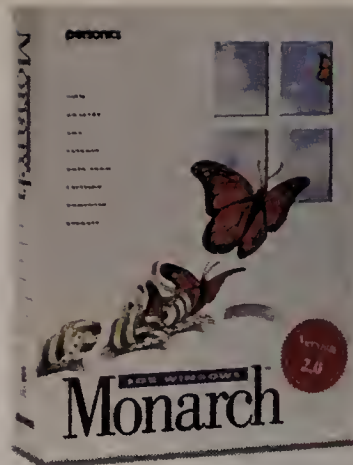
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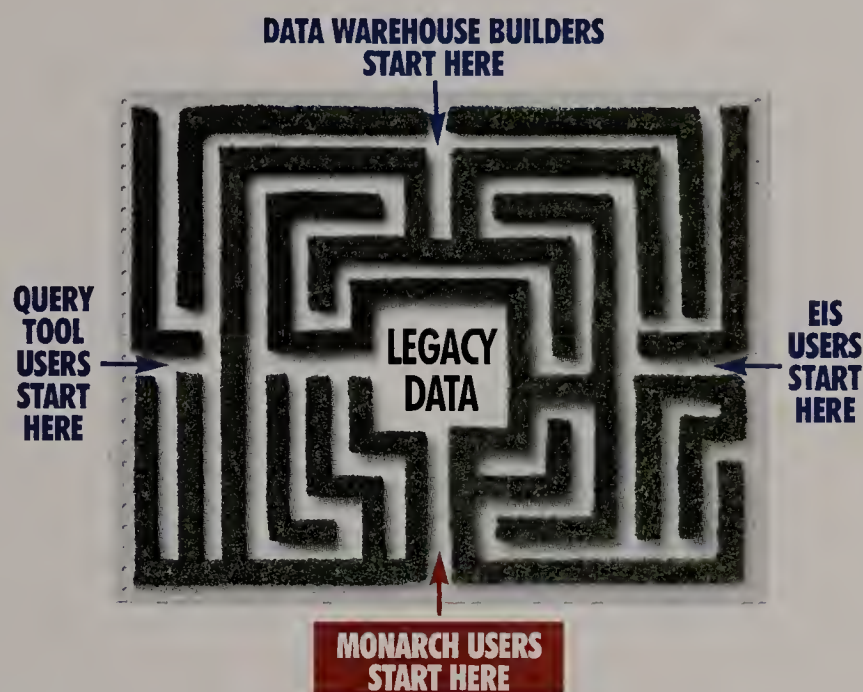
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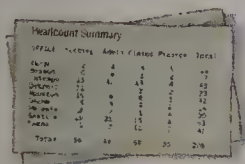
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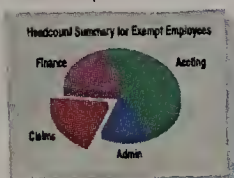
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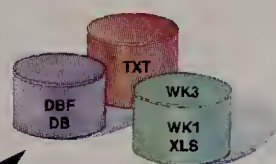
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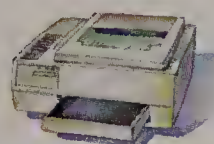
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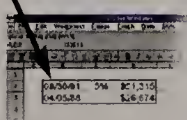
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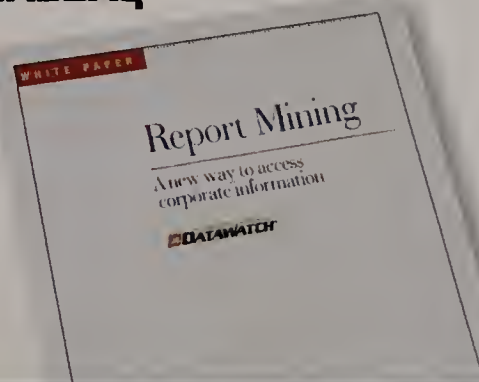
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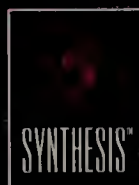
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